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Energy Statement

St Edward Homes Limited

Syon Gardens
Homebase Brentford Site

Final

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Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project. We are able to advise at all stages of projects from planning applications to handover. Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

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Executive Summary

The purpose of this Energy Statement is to outline the proposed energy strategy for the full planning application for the development at the Homebase Brentford Site, in the London Borough of Hounslow, by St Edward Homes Limited. The energy strategy has been formulated following the London Plan Energy Hierarchy: ***Be Lean***, ***Be Clean*** and ***Be Green***. This is an updated strategy in response to comments from the council on the Energy Statement submitted in September 2020 (Ref: P/2020/3099) as well as more recent comments from the Council's sustainability officer.

A range of advanced ***Be Lean*** energy efficiency measures are proposed. They enable the Development to achieve a **12%** reduction in regulated carbon emissions for the residential areas, and **24%** for non-residential areas, which exceeds the London Plan requirements. This also significantly exceeds minimum Part L 2013 requirements and shows a high level of fabric energy efficiency performance.

In line with the London Plan, the feasibility of decentralised energy production as a ***Be Clean*** measure has been carefully examined. There are no existing district heat networks in proximity to the Site. It is proposed that a site wide heat network is installed, supplying heat from a network sourced by high temperature air source heat pumps. All homes will be connected to the heat network, with connection points provided to all non-residential units (with the exception of the Tesco store, which will have a standalone heating strategy). Provision will be made for future connection to external heat networks. This delivers a site wide CO_2 reduction of **17%** over the Part L 2013 baseline.

The full spectrum of ***Be Green*** renewable energy generating technologies has been considered. Appropriate vailable roof space will be used to provide approximately 72.5 kWp of Solar PV.

Table *iii*, below, summarises the anticipated CO_2 emissions savings across the entire scheme following the ***Be Lean***, ***Be Clean*** and ***Be Green*** measures proposed. This results in an estimated Regulated CO_2 emissions reduction of **51%** over the Part L 2013 baseline, significantly exceeding London Plan policy requirements.

In line with the GLA guidance, the development will commit to offset the remaining CO_2 emissions for the whole development through a payment to the London Borough of Hounslow. The remaining CO_2 emissions to be offset are calculated in Table *iv* and are estimated as **396 Tonnes CO_2 per annum**, resulting in the estimated payment of **£1,128,600**, assuming the carbon offset price of £95 per tonne CO_2, for a period of 30 years.

With the proposed strategy, it is expected that the CO_2 emissions from the development will continue to reduce in the future with the ongoing decarbonisation of the electricity Grid. In reality, the CO_2 emissions will already be lower than presented in this report, as SAP 10 carbon emission factors have been used in line with GLA guidance, not the more up to date SAP 10.1 carbon emission factors.

Table *i*: Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy		
Stage	Carbon Dioxide Emissions [Tonnes CO_2 per Annum]	
	Regulated	Unregulated
Baseline: Part L 2013 Compliant Development	443	263
After *Be Lean* Measures	391	263
After *Be Clean* Measures	189	263
After *Be Green* Measures	176	263
Stage	Regulated Carbon Dioxide Savings	
	[Tonnes CO_2 per Annum]	Percentage
Savings from *Be Lean* Measures	53	12%
Savings from *Be Clean* Measures	202	46%
Savings from *Be Green* Measures	13	3%
Cumulative On-Site Savings	267	60%

Table *ii*: Non- Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy		
Stage	Carbon Dioxide Emissions [Tonnes CO_2 per Annum]	
	Regulated	Unregulated
Baseline: Part L 2013 Compliant Development	364	366
After *Be Lean* Measures	276	366
After *Be Clean* Measures	220	366
After *Be Green* Measures	220	366
Stage	Regulated Carbon Dioxide Savings	
	[Tonnes CO_2 per Annum]	Percentage
Savings from *Be Lean* Measures	88	24%
Savings from *Be Clean* Measures	56	15%
Savings from *Be Green* Measures	0	0%
Cumulative On-Site Savings	144	40%

Table *iii*: Site Wide Carbon Dioxide Emissions and Cumulative Savings			
Stage	Regulated Carbon Dioxide Emissions [Tonnes CO_2 per Annum]	Regulated Carbon Dioxide Savings	
		Tonnes CO_2 per Annum	Percentage
Baseline: Part L 2013 Compliant Development	807	-	-
After *Be Lean* Measures	666	141	17%
After *Be Clean* Measures	409	258	32%
After *Be Green* Measures	396	13	2%
Cumulative On-Site Savings	-	412	51%

Table *iv*: Carbon Offset			
	Residential	Non-Residential	Total
Residual CO_2 [TCO_2/year]	176	220	396
Carbon Price (£/t)	£95	£95	£95
Carbon Offset Payment	**£501,600**	**£627,000**	**£1,128,600**

V18 Updates – Response to Council Comments

This version responds to comments from the Council's Sustainability Officer in February 2021. Table v, below, summarises the comments, gives brief responses, and highlights where in the report the comments are addressed.

Table v: Summary of version updates

Comment	Response	Report Location
The glazing and external/to corridor walls proposed are not better than the notional part L dwelling. This should certainly be lower than the notional dwelling.	Achieving a 12% reduction over Part L 2013 shows that a good fabric energy strategy is proposed and is in excess of the minimum 10% policy standard. It is considered an appropriate and balanced strategy. All areas meet the notional dwelling requirements as a minimum, and many areas target improved performance (floors, roofs, ventilation). This balances out the areas that do not exceed notional dwelling targets (walls, glazing), but the cost and technical practicalities of improved performance in these areas is not considered practical for the amount of performance gain it gives. Regarding the walls, non-flammable insulation (e.g. Rockwool) will be used to limit fire risk in the façade. Thicker amounts of non-flammable insulation products are required to achieve the same thermal performance as could be achieved with phenolic insulation that has a lesser fire rating. The thickness of the wall to achieve a U-value of 0.18 W/m^2K is already significant (approx. 450-500mm), and to increase it further would make it significantly challenging and costly to maintain structural integrity in the walls.	Section 5, Paragraph 5.2
It looks as the area of PV is optimised, however the assumed efficiency of 250W is disappointing, I would push for 370w or preferably 400w.	The energy hierarchy approach has been followed. Therefore, attention and investment has been focused on energy efficiency and on the heat network. Substantial improvements over the minimum requirements have been achieved, particularly on the heat network. This is considered a more beneficial investment in carbon terms than on PV. It is important to note here that the carbon benefit of PV declines over time in the future because of the decarbonisation of the electricity grid. Conversely, the carbon benefit of heat pumps increases over time for the same reason. Focusing the investment on the heat pumps is therefore considered to be preferential. The roof space that is available for PV has been maximised. The assumptions made to calculate the kWp output of the solar PV is considered to estimate the minimum performance that can be expected from solar PV within this roof area. The layout, type and performance of panels will be considered further at the detailed	Section 7, Paragraphs 7.13-7.15

	design stage. It is expected that actual performance of the solar PV array will be equal to, or improve upon, estimates within this report.	
The offsetting figure uses £60/tonne, not £95, and also covers only the residential which is in line with the current London Plan but not the 'very material consideration' of the overdue updated London Plan.	The carbon offset calculations have been updated, assuming the price of £95 per tonne CO_2 for a period of 30 years. This has been calculated to include both residential and non-residential development.	Section 9
BREEAM Very Good is targeted. Not Excellent. If mechanisms can be put in place to require a BREEAM Fit out Excellent I would recommend this.	The developer is only committed to providing the Shell of the Tesco Store. They will ensure that Excellent is achieved for the Shell only development, as this is the element that is within their control. The energy performance already achieved the required standards for BREEAM Excellent, so not updated within this report. The Sustainability Statement has been updated to confirm this,	See Sustainability Statement

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Appendix I Whole Life Cycle Assessment Report

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Appendix K Indicative PV Locations

1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development. The statement sets out the energy strategy on behalf of St Edward Homes Limited (The 'Applicant') in respect to the planning application for the development of the Homebase Brentford site. The Site is situated within the London Borough of Hounslow.

1.2 This document presents an updated heating strategy in response to comments from the council on the previous version the Energy Statement issued in September 2020 (Ref: P/2020/3099).

1.3 The energy strategy for the site has been formulated to address a number of key objectives:

- To provide comfortable high-quality homes that people aspire to live in;
- To be low carbon from the outset;
- To adapt to climate change;
- To take account of specific site characteristics that link to the energy strategy, for instance acoustics and air quality;
- Provision of a resilient supply of low-cost heat to residents;
- Address energy planning policy.

1.4 A number of these objectives compete with each other. This energy strategy and the development proposals seek to provide a sensible balance between them.

1.5 In Line with GLA's Energy Assessment Guidance (2020), SAP10 carbon emission factors have been used to estimate carbon emissions from the development. Despite this, the calculations have also been tested against the current Part L 2013 to ensure there are no Building Regulation energy compliance issues.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 St Edward Homes Limited is bringing forward the redevelopment of both the Tesco Osterley and Homebase Brentford sites. The existing Tesco store would be re-provided on the Homebase site as part of a mixed-use development with residential above, which releases the opportunity to deliver a comprehensive residential-led mixed-use development on the Tesco site.

2.2 The Homebase Brentford site on Syon Lane is approximately 1.4 hectares and is located on the eastern corner of the junction between Syon Lane and the Great Western Road in Brentford, TW7 5QE within the London Borough of Hounslow, as shown in

2.3 Figure 1, below.

Figure 1: Site Location (Map data © 2019 Google)

2.4 The site is developed with a large Homebase store (4,180sqm) and associated surface car parking and under-croft car parking (295 spaces). The Homebase store comprises of a large industrial style shed with metal cladding. The building is effectively two storeys high with a central pylon to the front.

2.5 The site is bound by the A4 Great West Road to the north, and Syon Lane to the south-west. There is a car showroom to the east, and a service road, Syon Gate Way which extends along the south-eastern boundary, and further along is the railway line.

2.6 The site is 400 metres from the nearest small neighbourhood centre at 1-9A Spur Road and 142-156 London Road which south-east of the Tesco Osterley Site. St Johns Road Neighbourhood Centre is around 2km to the south of the site. The site is also approximately 900 metres west from Brentford Town Centre and over 2km east from Hounslow Town Centre.

2.7 The site has a public transport accessibility rating of PTAL 2/3. The southern part of the site falls into a PTAL 3 area, due to its proximity to bus services on London Road. Syon Lane station is in Zone 4. National Rail services direct to London Waterloo, Richmond and Weybridge. Furthermore, Osterley Station provides access to the Piccadilly line service and is within 2km of the site. There are bus stops directly adjacent to the site on A4 Great West Road and Syon Lane within 50m. Bus stops on London Road, adjacent to Syon Park are also accessible to the site, approximately 600m south of the site.

2.8 The surrounding area comprises a mix of uses including commercial and residential development. There are semi-detached houses on the western side of Syon Lane, opposite the site. Along the Great West Road there is a variety of commercial and industrial uses as well as some residential uses, and further along Syon Lane the uses are predominantly residential.

2.9 The existing site was designed by architect Sir Nicholas Grimshaw in 1987 and consists of a large industrial style shed with metal cladding. The current building is effectively 2 storeys high. Figure 2, below, shows the existing site.

Figure 2: Existing Site

Description of Development

"Full planning application for the demolition of existing building and car park and erection of buildings to provide residential units, a replacement retail foodstore, with additional commercial, business and service space, and a flexible community space, and ancillary plant, access, servicing and car parking, landscaping and associated works"

Summary of Scheme

2.10 The development will comprise of:

- Delivery of 473 high quality homes;
- 38% affordable housing (on a habitable room basis);
- A new and modern Tesco retail store of circa 10,550 sqm (GIA);
- 200 sqm (GIA) community space;
- 137 sqm (GIA) of flexible commercial, business and service space;

> 400 retail car parking spaces;

> 100 residential car parking spaces, 3 residential visitor car parking spaces and 2 car club spaces;

> 204 retail cycle parking spaces and 896 residential cycle parking spaces;

> Building heights include a four-storey podium with blocks ranging up to seventeen storeys.

2.11 Key site constraints relevant to the energy strategy are the acoustic & air quality environments. This is due to being on the flightpath into Heathrow as well as being adjacent to the Great West Road and a railway line. Further detail is found within the Acoustic Report submitted with the application.

3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements will inform the energy strategy for the development.

National Planning Policy

3.2 The revised National Planning Policy Framework (NPPF) was published on the 19th February 2019 and sets out the Government's planning policies for England.

3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.

3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:

a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) **An environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy

Adopted London Plan (March 2021)

3.5 The London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The policies, which are listed below, are considered relevant to the proposed development and this Statement:

3.6 **Policy SI2 Minimising Greenhouse Gas Emissions**, states:

'Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) *Be lean: use less energy and mange demand during operation;*

2) *Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly;*

3) *Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.*

A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 percent through energy efficiency measures.'

3.7 **Policy SI3 Energy Infrastructure**, states:

'Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) *Connect to local existing or planned heat networks;*

b) *Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);*

c) *Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network);*

d) *Use ultra-low NOx gas boilers.'*

3.8 **Policy SI4 Managing Heat Risk** seeks for energy strategies to demonstrate how they intend to reduce the risk of internal overheating, in line with the cooling hierarchy. This is further examined in the Overheating Report in Appendix F.

Local Policy: London Borough of Hounslow

Adopted Hounslow Local Plan 2015 - 2030

3.9 The Hounslow Local London Plan was adopted on 15th September 2015 by Hounslow Borough Council. Until 2030, it will form part of the planning framework of the borough.

3.10 Hounslow Local Plan 2015 to 2030 volume one has the following requirements for Environmental Quality:

> Policy EQ1 – Energy & Carbon Reduction, requiring all developments to "meet the carbon emission reduction requirements set out in the London Plan".

> Policy EQ2 – Sustainable Design and Construction, stating that "all new development should meet the standards for sustainable design and construction set out in the London Plan, including any of the 'optional' Building Regulations requirements it adopts"

Policy Target Summary

3.11 The policy targets can be summarised as:

> Residential units to achieve a 10% reduction in carbon emissions from energy efficiency, with 15% for non-residential;

> Maximising on-site carbon savings, with a minimum 35% reduction over Part L 2013;

> Carbon offsetting payments for residual carbon of residential dwellings.

4. METHODOLOGY & CARBON EMISSIONS BASELINE

Methodology

4.1 In line with the GLA's Energy Assessment Guidance (2020), the CO_2 emission performance against London Plan policies will be assessed using "SAP 10.0" carbon emission factors. This is to better estimate actual carbon emissions from the proposed development compared to Part L 2013 emission factors. As such, this approach reflects the objectives listed within the Introduction to this document.

Residential

4.2 The estimated energy demand for the residential portion of the development has been calculated using Standard Assessment Procedure (SAP 2012) methodology. SAP calculates the Regulated energy demand for residential dwellings.

4.3 SAP calculations have been carried out for ten representative home types. These encompass ground, mid floor and top floor flats. Therefore, these represent a fair aggregation of the unit mix of the site.

4.4 In order to calculate energy demands across the entire scheme, the accommodation schedule detailing the number of residential units per type has been used to extrapolate the results from the modelled units.

4.5 The Unregulated energy demands for the residential development has been calculated using the methodology outlined in the SAP 2012 document (version 9.92 – October 2013). This calculates the CO_2 emissions associated with appliances and cooking. The Unregulated energy demands for the non-residential areas have been taken from the BRUKL documents.

4.6 In line with GLA guidance, the GLA's Carbon Emissions Reporting spreadsheet (v1.1 2018) has been used to convert the predicted energy performance of the development using SAP 10 carbon emission factors.

Non-Residential

4.7 The estimated annual energy demand for the non-residential elements of the development has been calculated using Simplified Building Energy Model (SBEM) software, developed using the National Calculation Method (NCM 2013 Edition). SBEM calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items, as well as the Unregulated energy demands.

4.8 Sample SBEM calculations have been carried out on representative areas of all non-domestic uses. Results from these calculations have been extrapolated in order to gain energy demand estimates for the outline scheme.

4.9 Future alterations to Part L for non-residential have not yet been consulted upon. As such, SBEM2013 calculations have been undertaken with appropriate conversions made to allow for SAP 10 carbon factors.

Baseline Carbon Emissions

4.10 Table 1, below, shows the baseline Regulated, Unregulated & Total CO_2 emissions for the development. TER and BRUKL worksheets supporting these emissions are presented in Appendices A and D respectively.

Table 1: Part L2013 Baseline (SAP 10 Carbon Factors)

	Regulated [TCO_2/year]	Unregulated [TCO_2/year]	Total [TCO_2/year]
Residential	443	263	706
Non-Residential	364	366	730
Total	807	629	1,436

4.11 In addition to the TER, the residential areas will need to meet the Target Fabric Energy Efficiency (TFEE) requirement. A floor weighted average TFEE of 42.38 kWh/m^2/year has been calculated for the development.

5. BE LEAN: DEMAND REDUCTION

5.1 The first stage of the London Plan Energy Hierarchy is demand reduction from fabric energy efficiency measures. A number of measures are proposed in order to reduce energy demands across the development. The fabric energy strategy will aim to go above and beyond baseline Part L 2013 CO_2 emission reduction requirements and meet the London Plan target of 10% reduction in CO_2 emissions for residential and 15% for non-residential from the ***Be Lean*** stage of the energy hierarchy. Achieving these standards shows a very high level of fabric energy efficiency performance.

5.2 The proposed energy strategy for this development is considered the most appropriate combination of measures to achieve policy requirements. Most areas of the proposed specification exceed the targets within the SAP notional dwelling. Increasing the wall thickness would result in a reduction in floor area of the dwellings, which is considered too significant an impact in comparison to the reduction that a lower wall U-value would give. Additionally, for the walls, non-flammable insulation (e.g. Rockwool) will be used to limit fire risk in the façade. Thicker amounts of non-flammable insulation are required to achieve the same thermal performance as could be achieved with phenolic insulation that has a lesser fire rating. The required thickness of the wall to achieve a U-value of 0.18 W/m^2K is already significant (450-500mm), and to increase it further would make it significantly challenging and costly to maintain the structural integrity of the walls.

5.3 The fabric energy efficiency strategy should be reviewed at each detailed stage of the development, to ensure the most recent policy targets are being achieved.

Residential

Building Fabric

5.4 The following fabric energy efficiency targets have been assumed to estimate the energy performance for the proposed development:

> Double glazing with a whole unit U-value of 1.40 $W/m^2.K$, and a g-value of 0.40 as recommended in the overheating assessment;

> External wall U-values of 0.18 $W/m^2.K$;

> Corridor wall U-values of 0.18 $W/m^2.K$ (total required wall thickness 300mm and above);

> Party walls will be fully insulated and sealed (achieving an effective U-value of 0.00 $W/m^2.K$);

> Flat roofs with a U-value of 0.10 $W/m^2.K$;

> Exposed floors with a U-value of 0.10 W/m².K.

Air Tightness & Ventilation

5.5 All dwellings will be fitted with an efficient **Mechanical Ventilation with Heat Recovery (MVHR)** system. This system provides a whole dwelling ventilation system that supplies and extracts air, reusing hear that would have been lost, as illustrated in Figure 6. The dwelling MVHR unit should target a specific fan power (SFP) of 0.42-0.44 W/l/s and have an efficiency of 91%.

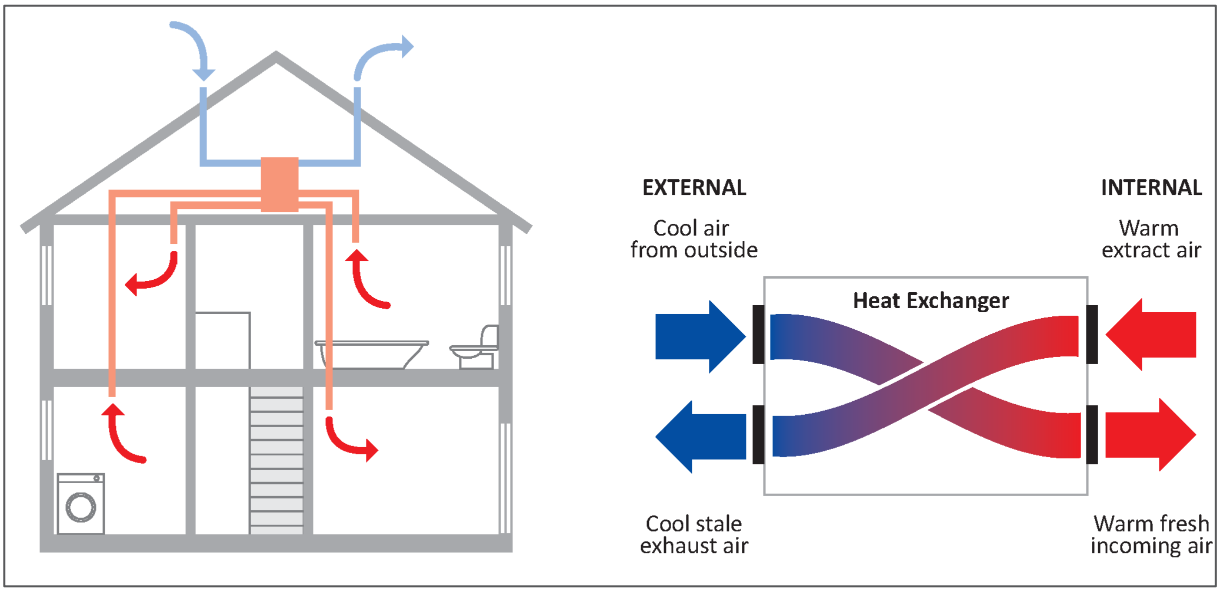

Figure 3: Mechanical Ventilation with Heat Recovery

5.6 All dwellings will be air tested on completion and will target a design air permeability rate of **3.0m³/hr.m².**

5.7 Additionally, all dwellings will have openable windows and therefore the ability to naturally ventilate should the occupant desire. This will facilitate convective ventilation and night purging of heat.

Thermal Bridging

5.8 In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which arise when elements are disrupted by changes in construction or penetrations through the insulation layer, as shown in Figure 4.

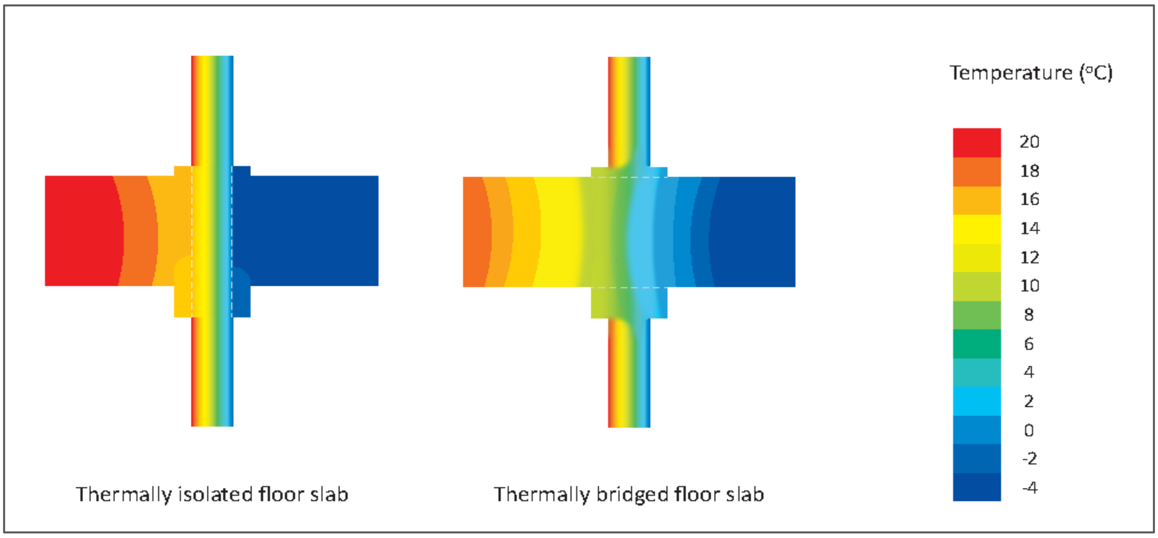

Figure 4: Thermal Bridges

5.9 Part L1A now places increased importance on addressing heat losses through thermal bridging. As such, the Applicant is committed to develop a building fabric where these are minimised as far as practicable.

5.10 The analysis of construction details would be premature at this stage; however, the Applicant is committed to assessing and improving the heat lost through thermal bridges. Bespoke calculations that improve on the default psi values will be targeted. The target psi values at this stage are summarised in Table 2. These target psi values are based on what has been achieved on schemes with a similar construction.

Table 2: Thermal Bridging Psi Value Targets			
SAP Ref.	Junction	Default value	Target performance
E1	Lintels	1	0.20
E3	Sill	0.08	0.04
E4	Jamb	0.1	0.05
E5	Ground floor to external wall	0.32	0.16
E20	Exposed floor to external wall	0.32	0.32
E7	Intermediate Floor	0.14	0.10
E23	Balconies	1	0.20
E15	Flat roof with parapet	0.56	0.40
E16	External corner	0.18	0.09
E17	Inverted corner	0.00	-0.09
E18	Party corner	0.12	0.06
P7	Party exposed floor	0.16	0.10
P4	Party roof	0.24	0.15

Space Heating & Hot Water

5.11 At the ***Be Lean*** stage, it is assumed the heating and hot water is supplied by a communal gas boiler system, with an efficiency of 89.5% for the residential areas & 92% for the non-domestic areas.

5.12 It is proposed that hot water will be supplied by means of a Heat Interface Unit (HIU), installed in each dwelling. No temperature top-up is required at the HIU – the heat network will supply sufficient temperature for space heating and hot water.

5.13 The HIU unit should be from a supplier whose product has been tested by an independent third-party, such as BESA (Building Engineering Service Association) to enable performance to be evaluated.

5.14 Heat loss of HIU should be minimized by fully insulating:

> Whole unit;

> Valves;

> Pipework from HIU to the connection point;

5.15 Heat loss 0.744 kWh per day has been specified for the SAP calculations.

Lighting

5.16 Energy efficient lighting will be installed in 100% of internal fittings in the homes. External lighting will also be low energy lighting and controlled through PIR sensors, daylight cut-off devices, or time switches where possible.

5.17 The electricity used for lighting is calculated according to the procedure described in SAP 2012, Appendix C. The calculation of lighting energy use is based on the quantity and efficacy of the fixed lighting, and on the contribution of daylight. Where it is not possible to obtain the efficacy of fixed lighting from manufacturer's data, default luminous efficacy should be used.

Unregulated Energy Demands

5.18 Unregulated energy demands are typically defined as the energy needed for cooking and powering appliances within the home. There is difficulty in reducing the energy associated with these uses as they are entirely dependent on the occupant of a home and can vary substantially. However, the Applicant is committed to ensuring that all efforts are made to enable the residents to minimise their unregulated electricity consumption.

Mitigation against Summer Overheating

5.19 A separate Summer Overheating Mitigation Report has been prepared for the development as part of this application and it is attached to this report in Appendix F.

5.20 In line with the Cooling Hierarchy within London Plan Policy SI 4, it is proposed to reduce the need for active cooling as far as possible. A dynamic overheating assessment has been completed for the residential areas, in line with guidance published by the Chartered Institute of Building Services Engineers (CIBSE) guidance document TM59: Design methodology for the assessment of overheating risk in homes (2017). Assumed worst case units have been modelled against a range of weather data to assess performance in both current and predicted future climates.

5.21 The results of this assessment are presented in the Dynamic Overheating Assessment report, which is provided in Appendix F. This report includes results from dynamic overheating modelling in line with CIBSE TM59, plus the GHA domestic overheating checklist.

5.22 The results indicate that the development has incorporated as many passive design solutions as practical following the cooling hierarchy and effectively accounting for noise constraints to reduce the risk of overheating. Proposed passive measures are as follows:

> Reduced glazing ratio and solar control glass specifications (g-value of 0.4)

> Raised sill height where possible massing arrangement and use of external shading in form of balconies to reduce solar gains and provide shades

> Natural ventilation through open windows during unoccupied hours to limit residents' exposure to external noise

> Use of trees and vegetation at podium level to provide additional shadings

> Background mechanical ventilation to assist natural ventilation

5.23 Throughout the design process, St Edward and the design team has developed a fabric specification that takes into account the site constraints and environmental considerations. These include; building form and massing and its impact on energy efficiency; noise impact; air quality; sunlight and daylight; the internal overheating of dwellings and CIBSE TM59 compliance. Further passive measures were considered by the design team during the course of the design evolution. Multiple iterations and scenarios were tested in order to ensure that compliance with the overheating requirements was achieved as far as possible.

Non-Residential

5.24 The proposed servicing strategies for the shell non-domestic units will fall under the responsibility of future tenants. However, as the developer is responsible for the fabric elements, these will meet the requirements outlined within this section of the Energy Statement. The efficiency of services will be discussed and negotiated with potential tenants as the development progresses.

Building Fabric

5.25 The Tesco unit within the development should aim to achieve the following fabric energy efficiency targets:

> External Wall U-values of 0.18 W/m^2K;

> Exposed Floor U-value of 0.25 W/m^2K;

> Glazing U-value of 1.3 W/m^2K, with a g-value of 0.32 and light transmittance of 0.59.

5.26 Other non-residential units within the development (Kiosk, Community, Residential facility) should aim to achieve the following fabric energy efficiency targets:

> Ground Floor U-Values of 0.25 W/m^2K;

> External Wall U-values of 0.18 W/m^2K;

> Exposed Floor U-value of 0.1 W/m^2K;

> Glazing U-value of 1.3 W/m^2K, with a g-value of 0.3 and light transmittance of 0.6.

Ventilation

5.27 It is anticipated that the Tesco non-residential unit will utilise a Fan Coil Unit with Heat Recovery system. The specification of this system will be the responsibility of the tenant fitting out the unit. The unit performance should be:

> Specific Fan Power (SFP) of 1.5 W/l/s;

> ≥ 85% heat recovery;

> MVHR controls: Summer bypass.

5.28 The other non-residential units (Kiosk, Community, Residential facility) across the development will utilise a very efficient Mechanical Ventilation with Heat Recovery.

- Specific fan power of 1.3 W/l/s;
- 85% heat recovery;
- MVHR controls: Summer bypass and demand control ventilation (variable speed control with CO_2 sensors).
- Extract fans for WCs: specific fan power: 0.3 W/l/s

5.29 All units should target an air permeability rate that is below the default of $5m^3/m^2.h$.

Lighting

5.30 The Tesco unit is proposed to have high efficiency LED lighting throughout to a minimum 80 lm/W and light output ratio 1. It is assumed photoelectric lighting with dimming will be in all perimeter zones, and occupation sensor auto on/off controls utilised.

5.31 The other non-residential units (Kiosk, Community, Residential facility) are assumed to have high efficiency LED lighting throughout to a minimum 120 lm/W and light output ratio 1. It is assumed photoelectric lighting with dimming will be in all perimeter zones, and occupation sensor auto on/off controls utilised. Display lighting for dining room to have 110lm/W.

Space Heating and Hot Water

5.32 At the ***Be Lean*** stage, it is assumed that the heating and hot water to the non-residential units is supplied by a communal gas boiler, with an efficiency of 91%.

Cooling

5.33 The risk of excessive solar gains has been evaluated for the non-domestic spaces through SBEM software. All units assessed demonstrate sufficient measures to avoid excessive solar gains. The cooling demand for these units will be provided by an efficient heat pump system, the demands for which have been included within the CO_2 emissions assessment.

5.34 The final performance of the heat pump system for cooling will be the responsibility of the tenant fitting out the unit. Energy Efficiency Ratio (EER) and Seasonal Energy Efficiency Ratio (SEER) have been assumed to be:

- The Tesco unit: SEER: 6.0, EER: 4.0
- The other non-residential units (Kiosk, Community, Residential facility): SEER: 6.5, EER: 4.10

5.35 The cooling demands for the retail and office spaces are shown in Table 3 below.

Table 3: Cooling Demands - Non-Domestic Areas		
Scheme Component	Area weighted average non-domestic cooling demand [MJ/m^2]	Total area weighted non-domestic cooling demand [MJ/year]
Actual	144	1,167,000
Notional	223	1,712,000

CO_2 Emissions at Be Lean Stage

5.36 Table 4, below, shows the estimated carbon performance as a result of applying the energy efficiency measures outlined in the above.

5.37 These measures result in a CO_2 emission reduction of **12%** for residential units and **24%** for non-residential units over the Part L 2013 baseline, which exceeds London Plan policy requirements and is a significant improvement on Part L 2013 minimum standards, showing a high level of fabric energy efficiency performance. A calculation of these results is presented in Appendix C. Full SAP worksheets & BRUKL Outputs worksheets supporting these calculations are presented in Appendices A and D respectively.

Table 4: Be Lean using SAP 10 Carbon Factors (Regulated CO_2)			
	Baseline (Part L 2013) [TCO_2/year]	Be Lean [TCO_2/year]	Reduction Achieved [%]
Residential	443	391	12%
Non-Residential	364	276	24%
Total	807	666	**17%**

Whole Life Cycle Assessment

5.38 A whole life cycle assessment has been carried for the development. A separate report has been produced and it is shown in Appendix I.

6. BE CLEAN: HEATING INFRASTRUCTURE

6.1 In line with the London Plan Policy SI3 Energy Infrastructure, the heat source for the onsite communal heat network has been considered in line with the following hierarchy:

a. connect to local existing or planned heat networks

b. use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

c. use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

d. use ultra-low NOx gas boilers

Connection to Local Existing or Planned Heat Networks

6.2 The London Heat Map has been reviewed to see if there are any existing or planned heat networks within the vicinity of the site, which is shown in Figure 5. No networks are shown.

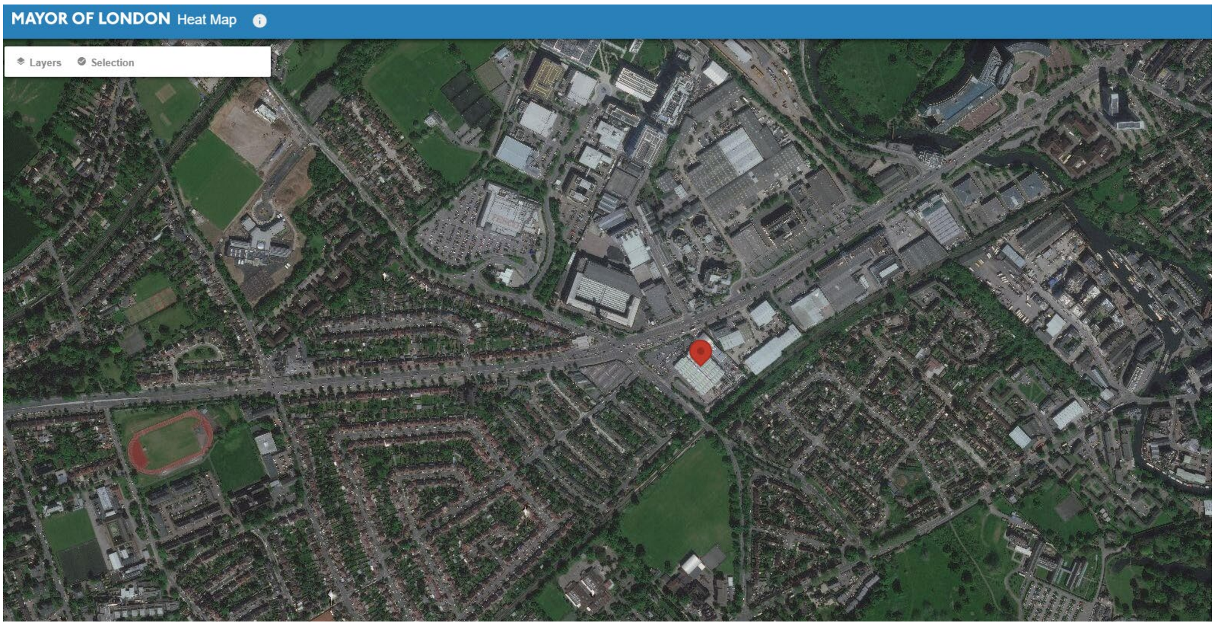

Figure 5: London Heat Map (https://maps.london.gov.uk/heatmap/projects/homebase-syon-lane-heat-network-1)

6.3 Furthermore, there is no Hounslow Energy Masterplan to consult on this issue.

6.4 Consideration has also been given to potential heat sources that are not shown on the Heat Map. The Sky campus is the only potential site identified. They have been contacted in relation to the supply of heat with no response from their side. Evidence shown in Appendix J.

6.5 Therefore, connection to existing or planned heat networks is not possible. An onsite strategy is therefore to be adopted to provide heat to all homes from a single Energy Centre. Connection points will also be provided to the non-residential units, with the exception of the Tesco store, which will have a standalone heating strategy.

6.6 It is not proposed to connect the Tesco store to the heat network, as it is a large store that has significant heating and cooling demands. It is more efficient for the store to have both heating and cooling provided from the same plant instead of a separate heating and cooling plant.

6.7 It is proposed that the heating and cooling demand of the Tesco store will be provided by heat pump with seasonal coefficient of performance (SCOP) > 4.2.

Zero-Emission or Local Secondary Heat Sources (with Heat Pumps)

6.8 Consideration has been given to the available secondary heat sources. Ground source heat pumps require extensive groundworks which have high capital cost, and is not considered appropriate for the Proposed Development. There are no known water source or waste heat sources in close proximity to the development. Only air is considered feasible. Therefore, it is proposed that the lead heat source for the development is air source heat pumps.

6.9 It is proposed that the heating and hot water for the development is provided by a heat network led by high temperature air source heat pumps.

6.10 The current proposed strategy is to utilise high temperature heat pumps, which can supply 100% of the energy demand meaning electricity is used as the fuel source. In a single stage these would increase the water temperature from 30^{o}C and 60^{o}C.

6.11 A minimum seasonal coefficient of performance (SCOP) of 3.0 can be expected from this type of heat pump. The final plant selection and design may have a slightly better performance, but 3.0 has been assumed to ensure that the performance allowed for can realistically be achieved in construction.

6.12 It is expected that a distribution loss factor of 1.3 can be achieved. Heat losses are assumed to align with the CIBSE Heat Networks Code of Practice, which the heat network will adhere to in the design and construction of the network.

6.13 For resilience, gas boilers are to be designed to the full peak capacity of the site. This would only be used in the event of heat pump failure.

6.14 These units are to be located in the roof of Block C and fed down to the Energy Centre which is located in the basement of Block C. An indicative roof plan of Block C is provided within Appendix G to illustrate the extent of the heat pump external units.

6.15 In addition to the heat pump internal units and back-up gas boilers, the Energy Centre will also contain thermal stores and other ancillary plant. The Energy Centre has been sized at 191.6 m^2, with a floor to ceiling height of 5m. This is illustrated within the drawings in Appendix H. This was based on the previous strategy. The updated strategy may enable a reduction in size of the energy centre, but plenty of space has been allowed for.

6.16 The Energy Centre could easily be adapted in the future for connection to an area-wide heat network should one become available and it was appropriate to connect. This would be achieved through replacement of some heat generating plant (i.e. boilers, heat pump or thermal store) with interposing heat exchangers. The potential for future connection has been fully incorporated into the design. However, full measures to facilitate this (such as the heat exchangers) will not be installed until required, as there is a risk they will be incorrectly designed when full details of the potential heat network, including network temperatures, is not known.

Heat Network Operation

6.17 Heat networks within Berkeley Group schemes provide a fully managed service, either through ESCO contracts or contracts for operation, maintenance, and customer services. These provide all necessary information to residents when they move in (a welcome pack) and throughout. Furthermore, HIUs are generally serviced at regular intervals without call-out charge.

6.18 Standard monitoring of the Energy Centre and heat network will be undertaken during operation. As a minimum, meters will be provided for: incoming utilities, bulk heat output of the Energy Centre; and inputs/outputs from the heat pumps. This allows boiler and heat pump efficiencies to be calculated.

Air Quality

6.19 Information of the air quality assessment can be found within the Environmental Statement submitted as part of the planning application (Ref: P/2020/3099). The assessment has not been updated with the updated heating strategy, but it is expected that emissions would reduced with the updated strategy. The conclusions of the assessment carried out previously (which did not identify any significant effects) remains valid and represents a worst case scenario.

6.20 Boilers will be provided as a back up, but it is only intended that these would be used in the event of heat pump failure. It is not expected that they will often be required, but they are provided for resilience.

CO_2 Emissions at Be Clean Stage

6.21 Table 5, below, shows the expected CO_2 reduction following the ***Be Clean*** measures, this has been calculated using SAP 10 carbon emission factors.

Table 5: Be Clean using SAP 10 Carbon Factors (Regulated CO_2)

	Be Lean [TCO_2/year]	Be Clean [TCO_2/year]	Reduction Achieved [%]
Residential	391	189	46%
Non-Residential	276	220	15%
Total	**666**	**409**	**32%**

7. BE GREEN: RENEWABLE ENERGY

7.1 The final part of the London Plan Energy Hierarchy is ***Be Green*** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO_2 emissions.

7.2 This section outlines the feasibility of a range of renewable energy technologies for the development.

7.3 The policy requirement for an onsite 35% reduction in CO_2 emissions has been achieved through a focus on the upper parts of the energy hierarchy, namely energy efficiency measures and heat networks (with heat pumps). Therefore, no further technologies are required to achieve this policy target.

Biomass

7.4 Biomass boilers generate heat on a renewable basis as they are run on biomass fuel which is virtually carbon neutral. However, it does produce significant particulate matter (PM). This would have to be mitigated through selection of appropriate additional filtration systems.

7.5 Biomass fuel also required frequent delivery trucks, likely HGV trucks, to supply the fuel to the Site. This would increase local traffic leading to an increase in congestion and local pollution levels. Therefore, this option has not been considered the most appropriate technology for this development.

Wind Turbines

7.6 As an electricity generating technology, wind turbines would not conflict with the heat network. However, the development is situated in an urban location and is constrained. It has been shown that such locations often experience highly turbulent and low speed wind conditions. The development is also under a flightpath. Because of all of this, the installation of wind turbines would not be a cost-effective method for the generation of renewable energy. Wind turbines will therefore not be installed on Site.

Heat Pumps

7.7 Whilst reducing energy consumption, heat pumps replace gas as the heating fuel with electricity. The electricity grid is expected to decarbonise and therefore the emissions associated with this technology are likely to drop.

7.8 Ground source heat pumps (GSHP) can provide reductions in energy. However, they are generally limited to sites with large amounts of space. The development is located on a brownfield site. This increases the complexity and subsequent costs for applying the technology. As a result, GSHP have not been selected for this development.

7.9 Air source heat pumps (ASHP) are a more economical alternative to GSHPs as they do not require ground works.

7.10 Air source heat pump utilise the ambient air temperature to generate heat. Communal heat pumps are proposed for the development and have been considered in the ***Be Clean*** section of the report.

7.11 As mentioned previously, for Tesco the heating & cooling will be provided by heat pump with seasonal coefficient of performance (SCOP) > 4.2.

Photovoltaics (PV)

7.12 PV panels generate electricity from solar radiation. The generating potential of PV panels is not dependent on development demand, but only on available roof space for installation and ensuring that they are not over-shaded.

7.13 It is proposed to install solar PV on available roof space on Blocks A, D and E. Block C is being used for the heat pump units and is therefore unavailable. The upper roofs only of each block will be used for PV to ensure there will be no overshadowing. It is estimated that approximately 1,200m^2 is available for Solar PV. It is estimated this will provide approximately 72.5 kWp of PV, allowing for spacing between and around panels.

7.14 It is assumed that the panels will be tilted slightly by approximately 10^o and orientated towards the south. It is assumed that 50% of the available roof area is suitable for panels, to allow for the required spacing around and between panels, as well as maintenance access. Of the available space, it is assumed that 8m^2 would be required per kWp.

7.15 The availability of roof space for PV has been maximised. The assumptions outlined above is considered to be the minimum solar output (kWp) that could be gained from the available roof space. The actual sizing and efficiency of panels will be considered further at the detailed design stage, but it is expected that the final output would be equal to, or better than, the estimated amount within this report. An indicative roof layout showing the proposed locations of PV panels is shown in Appendix K. This will be reviewed at the detailed design stage.

CO_2 Emissions at Be Green Stage

7.16 Table 6 below shows the expected Regulated CO_2 emissions following the inclusion of the proposed ***Be Green*** measures, which results in a further 2% site wide CO_2 reduction. The benefit of the heat pump for the Tesco unit has been included within the ***Be Clean*** stage. The CO_2 reduction has been estimated using SAP 10 carbon emission factors.

Table 6: Be Clean using SAP 10 Carbon Factors (Regulated CO_2)			
	Be Clean [TCO_2/year]	Be Green [TCO_2/year]	Reduction Achieved [%]
Residential	189	176	3%
Non-Residential	220	220	0%
Total	409	396	2%

Further Decarbonisation

7.17 In addition to maximisation of heat pump use on the heat network, the feasibility of incorporating other renewable technologies (solar PV) has also been reviewed. Significant investment is being made by the applicant in a 100% heat pump strategy in order to substantially exceed minimum onsite carbon requirements.

7.18 This updated strategy is expected to achieve a site wide 51% CO_2 reduction, which significantly exceeds the minimum onsite CO_2 reduction target of 35% as required in London Plan policy, and, with the heating strategy intended to be 100% electric, is future-proofed to enable further carbon reductions in the future. This is currently considered to be the optimal energy strategy for the scheme, with the maximum CO_2 that can be achieved on site, taking into account the cost, practicality and feasibility of each area of the specification.

7.19 CO_2 emissions for the development will naturally continue to reduce over time with the ongoing decarbonisation of the grid. It is estimated that for the residential portion of the development, there would be approximately an 87% reduction in CO_2 emissions over a Part L 2013 baseline by 2030. This is shown in the table below.

7.20 It is expected that CO_2 emissions reduction will already be greater in reality than is presented in this report, as the BRE have issued more up to date “SAP 10.1” carbon emission factors, that supersede the SAP 10 emission factors that have been used as requested by the GLA.

	SAP10.0	**SAP10.1 (expected for Part L 2021)**	**BEIS 2030 Carbon Factors**
CO_2 reduction over Part L 2013 (Residential)	60%	77%	87%

8. BE SEEN

8.1 The new London Plan introduces a fourth stage to the energy hierarchy; the *'Be Seen'* stage, which requires monitoring and reporting of the actual operational energy performance of major developments for at least five years.

8.2 An effectively implemented post-construction monitoring regime can have a number of benefits including environmental (e.g. reduced grid infrastructure strain, carbon emissions reduction) and socio-economic (e.g. reduced occupants' bills, raised awareness around energy usage).

8.3 The ***Be Seen*** stage aims to ensure that the actual energy and carbon performance of buildings is aligned with the estimated energy and carbon performance will be a key factor in achieving a zero-carbon London.

8.4 Standard monitoring of the Energy Centre and heat network will be undertaken during operation. As a minimum, the following will be metered:

> Gas, electricity, and water used in the Energy Centre;

> Heat leaving the Energy Centre;

> Heat entering each block;

> Final customer heat consumption.

8.5 The metering and controls strategy is to be further developed during the detailed design process.

9. ZERO CARBON HOMES

9.1 Since 2016, London Plan policy has required that all major residential developments are subject to an additional offset payment to meet a 100% reduction in Regulated CO_2 emissions to achieve the standard of *Zero Carbon*. This payment is made to the local borough's Carbon Offsetting Fund and is expected to be allocated to carbon reduction savings elsewhere in the borough.

9.2 With the adoption of the new London Plan in March 2021, the carbon offset applies to non-residential development too.

9.3 The new London Plan sets the offset payment price for all development at £95 per tonne of Regulated CO_2 per year, for a period of 30 years.

9.4 The estimated remaining residential Regulated CO_2 emissions after the ***Be Lean***, ***Be Clean*** and ***Be Green*** stages of the Energy Hierarchy are calculated to be **176 tonnes CO_2 per annum** for the residential development, and **220 tonnes CO_2 per annum** for non-residential development. Therefore, the estimated payment due to the London Borough of Hounslow is **£1,128,600.** The calculation is shown in Table 7, below.

Table 7: Carbon Offset Payment

Stage	Residual CO_2 (Tonnes)	Offset Payment (£95/tonne/30yrs)
Residential	176	£501,600
Non-Residential	220	£627,000
Total	**396**	**£1,128,600**

9.5 These calculations should be refined at each detailed stage of the development. They should be updated based on the accurate heat network efficiencies and based on current Building Regulations and carbon factors at the time of application.

10. SUMMARY

10.1 The purpose of this Energy Statement is to outline the proposed energy strategy for the full planning application for the development at the Homebase Brentford Site, in the London Borough of Hounslow, by St Edward Homes Limited. The energy strategy has been formulated following the London Plan Energy Hierarchy: ***Be Lean***, ***Be Clean*** and ***Be Green***. This is an updated strategy in response to comments from the council on the Energy Statement submitted in September 2020 (Ref: P/2020/3099) as well as more recent comments from the Council's sustainability officer.

10.2 A range of advanced ***Be Lean*** energy efficiency measures are proposed. They enable the Development to achieve a **12%** reduction in regulated carbon emissions for the residential areas, and **24%** for non-residential areas, which exceeds the London Plan requirements. This also significantly exceeds minimum Part L 2013 requirements and shows a high level of fabric energy efficiency performance.

10.3 In line with the London Plan, the feasibility of decentralised energy production as a ***Be Clean*** measure has been carefully examined. It is proposed that a site wide heat network is installed, supplying heat from a network sourced by high temperature air source heat pumps. All homes will be connected to the heat network, with connection points provided to all non-residential units (with the exception of the Tesco store, which will have a standalone heating strategy). Provision will be made for future connection to external heat networks. This delivers a site wide CO_2 reduction of **17%** over the Part L 2013 baseline.

10.4 The full spectrum of ***Be Green*** renewable energy generating technologies has been considered. Available roof space will be used to provide approximately 72.5 kWp of Solar PV.

10.5 Table 8, below, summarises the anticipated CO_2 emissions savings across the entire scheme following the ***Be Lean***, ***Be Clean*** and ***Be Green*** measures proposed. This results in an estimated Regulated CO_2 emissions reduction of **51%** over the Part L 2013 baseline, exceeding London Plan policy requirements.

10.6 In line with the GLA guidance, the development will commit to offset the remaining CO_2 emissions for the whole development through a payment to the London Borough of Hounslow. The remaining CO_2 emissions to be offset are estimated as **396 Tonnes CO_2 per annum**, resulting in the estimated payment of **£1,128,600**, assuming the carbon offset price of £95 per tonne CO_2, for a period of 30 years.

10.7 With the proposed strategy, it is expected that the CO_2 emissions from the development will continue to reduce in the future with the ongoing decarbonisation of the electricity Grid. In reality, the CO_2 emissions will already be lower than presented in this report, as SAP 10 carbon emission factors have been used in line with GLA guidance, not the more up to date SAP 10.1 carbon emission factors.

Table 8: Site Wide Carbon Dioxide Emissions and Cumulative Savings			
Stage	Regulated Carbon Dioxide Emissions [Tonnes CO_2 per Annum]	Regulated Carbon Dioxide Savings	
		Tonnes CO_2 per Annum	Percentage
Baseline: Part L 2013 Compliant Development	807	-	-
After Be Lean Measures	666	141	17%
After Be Clean Measures	409	258	32%
After Be Green Measures	396	13	2%
Cumulative On-Site Savings		412	51%

APPENDICES

Appendix A
Full SAP 2012 Outputs – *Be Lean*

Appendix B
Full SAP 2012 Outputs– *Be Clean*

Appendix C
GLA Carbon Emission Reporting Spreadsheet

Appendix D
BRUKL Outputs – *Be Lean*

Appendix E
BRUKL Outputs – *Be Clean*

Appendix F
Dynamic Overheating Assessment report

Appendix G
Indicative ASHP Roof Plant Layout

Appendix H
Indicative Energy Centre Plan

Appendix I
Whole Life Cycle Assessment Report

Appendix J
Correspondence with Sky Campus

Appendix K
Indicative PV Locations

Appendix A

Full SAP 2012 – Be Lean

Property Reference	001 Block A2-1B2P-03281	Issued on Date	22/07/2020
Assessment Reference	1B2P no cooling	Prop Type Ref	Exposed Floor
Property	001 Block A2-1B2P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	DER	16.39	TER	19.63
Environmental	90 B	% DER<TER	16.50		
CO_2 Emissions (t/year)	0.72	DFEE	42.26	TFEE	52.53
General Requirements Compliance	Pass	% DFEE<TFEE	19.54		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	Assessor ID	T305-0001
Client	St Edward Homes		

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.39 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.3 kWh/m²/yrOK
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           0.10 (max. 0.25)       0.10 (max. 0.70)          OK
Roof            (no roof)
Openings        1.26 (max. 2.00)       1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                              OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Community heating scheme                          -

Secondary heating system:              None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                         OK
Primary pipework insulated:            No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                    No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                               OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.42
Maximum                                1.5                                               OK
MVHR efficiency:                       91%
Minimum:                               70%                                               OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):           Slight                                            OK
Based on:
Overshading:                           Average
Windows facing North:                  6.98 m², No overhang
Air change rate:                       2.00 ach
Blinds/curtains:                       None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                     0.00 W/m²K
Exposed floor U-value                  0.10 W/m²K
Door U-value                           0.82 W/m²K
Air permeability                       3.0 m³/m²h


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE     09 Jan 2014

1. Overall dwelling dimensions

                                                            Area          Storey height              Volume
                                                            (m2)                (m)                   (m3)
Ground floor                                           55.6000 (1b)    x      2.5000 (2b)     =    139.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          55.6000                                      (4)
Dwelling volume                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    139.0000 (5)

2. Ventilation rate

                                          main          secondary          other            total        m3 per hour
                                         heating         heating
Number of chimneys                          0      +        0      +        0      =          0 * 40 =     0.0000 (6a)
Number of open flues                        0      +        0      +        0      =          0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                  0 * 10 =     0.0000 (7a)
Number of passive vents                                                                      0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                 0 * 40 =     0.0000 (7c)

                                                                                         Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =           0.0000 / (5) =     0.0000 (8)
Pressure test                                                                                             Yes
Measured/design AP50                                                                                   3.0000
Infiltration rate                                                                                      0.1500 (18)
Number of sides sheltered                                                                                   3 (19)

Shelter factor                                                              (20) =  1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                              (21) = (18) x (20)  =     0.1163 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed     5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor    1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
               0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                   0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =               77.3500 (23c)

Effective ac   0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)

3. Heat losses and heat loss parameter

Element                                     Gross      Openings      NetArea      U-value        A x U       K-value         A x K
                                              m2            m2           m2        W/m2K          W/K        kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                      6.9800       1.3258       9.2538                           (27)
Door                                                                  2.1200       0.8200       1.7384                           (26)
Exposed                                                              55.6000       0.1000       5.5600                           (28b)
External Wall                             17.5000        6.9800      10.5200       0.1800       1.8936                           (29a)
Wall to Stairwell                         17.5000        2.1200      15.3800       0.1671       2.5695                           (29a)
Total net area of external elements Aum(A, m2)                       90.6000                                                     (31)
Fabric heat loss, W/K = Sum (A x U)                                      (26)...(30) + (32) =  21.0153                          (33)
Party Wall 1                                                         39.7500       0.0000       0.0000                           (32)
Party Ceilings 1                                                     55.6000                                                     (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                           250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                    8.7346 (36)
Total fabric heat loss                                                                        (33) + (36) =  29.7499 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m         11.9936    11.8603    11.7270    11.0604    10.9271    10.2605    10.2605    10.1272    10.5272    10.9271    11.1937    11.4603 (38)
Heat transfer coeff
              41.7435    41.6102    41.4769    40.8103    40.6770    40.0105    40.0105    39.8771    40.2771    40.6770    40.9436    41.2102 (39)
Average = Sum(39)m / 12 =                                                                                                        40.7770 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            0.7508     0.7484     0.7460     0.7340     0.7316     0.7196     0.7196     0.7172     0.7244     0.7316     0.7364     0.7412 (40)
HLP (average)                                                                                                                      0.7334 (40)
Days in month
                   31         28         31         30         31         30         31         31         30         31         30         31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy                                                                                            1.8549 (42)
Average daily hot water use (litres/day)                                                                    78.2543 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              86.0797    82.9495    79.8194    76.6892    73.5590    70.4289    70.4289    73.5590    76.6892    79.8194    82.9495    86.0797 (44)
Energy conte 127.6537   111.6468   115.2095   100.4424    96.3769    83.1659    77.0654    88.4337    89.4899   104.2919   113.8427   123.6258 (45)
Energy content (annual)                                                                               Total = Sum(45)m =  1231.2445 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
              19.1481    16.7470    17.2814    15.0664    14.4565    12.4749    11.5598    13.2651    13.4235    15.6438    17.0764    18.5439 (46)
Water storage loss:
Store volume                                                                                                      3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                      0.0212 (51)
  Volume factor from Table 2a                                                                                     3.4200 (52)
  Temperature factor from Table 2b                                                                                1.0000 (53)
Enter (49) or (54) in (55)                                                                                        0.2173 (55)
Total storage loss
               6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             157.6514   138.7415   145.2071   129.4724   126.3746   112.1959   107.0631   118.4314   118.5199   134.2895   142.8727   153.6235 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                 Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
             157.6514   138.7415   145.2071   129.4724   126.3746   112.1959   107.0631   118.4314   118.5199   134.2895   142.8727   153.6235 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =  1584.4432 (64)
Heat gains from water heating, kWh/month
              66.4430    58.7983    62.3053    56.6211    56.0435    50.8767    49.6224    53.4024    52.9794    58.6752    61.0767    65.1037 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              15.8446    14.0730    11.4449     8.6645     6.4768     5.4680     5.9084     7.6800    10.3080    13.0884    15.2761    16.2849 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             161.7305   163.4087   159.1796   150.1762   138.8111   128.1295   120.9935   119.3152   123.5444   132.5478   143.9129   154.5945 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746 (69)
Pumps, fans    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967 (71)
Water heating gains (Table 5)
              89.3051    87.4975    83.7437    78.6404    75.3272    70.6621    66.6968    71.7774    73.5825    78.8645    84.8288    87.5050 (72)
Total internal gains
             317.7039   315.8030   305.1920   288.3050   271.4389   255.0833   244.4224   249.5963   258.2587   275.3244   294.8415   309.2082 (73)

6. Solar gains

[Jan]                                   Area        Solar flux             g               FF            Access             Gains
                                          m2          Table 6a     Specific data    Specific data        factor                 W
                                                          W/m2       or Table 6b      or Table 6c      Table 6d
North                                 6.9800          10.6334          0.4000           0.7000           0.7700           14.4019 (74)

Solar gains   14.4019    27.5227    46.7678    75.1210   101.1949   108.3322   101.1419    80.2432    56.2300    32.7622    17.7665    12.0061 (83)
Total gains  332.1058   343.3257   351.9597   363.4260   372.6339   363.4155   345.5644   329.8395   314.4887   308.0866   312.6081   321.2143 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           92.4962    92.7925    93.0907    94.6112    94.9212    96.5026    96.5026    96.8252    95.8637    94.9212    94.3031    93.6930
alpha          7.1664     7.1862     7.2060     7.3074     7.3281     7.4335     7.4335     7.4550     7.3909     7.3281     7.2869     7.2462
util living area
               0.9974     0.9960     0.9912     0.9695     0.8865     0.6883     0.5078     0.5530     0.8199     0.9713     0.9942     0.9979 (86)

MIT           20.3335    20.4023    20.5395    20.7415    20.9123    20.9892    20.9989    20.9981    20.9632    20.7737    20.5281    20.3215 (87)
Th 2          20.2962    20.2983    20.3004    20.3109    20.3130    20.3235    20.3235    20.3257    20.3193    20.3130    20.3088    20.3046 (88)
util rest of house
               0.9966     0.9947     0.9882     0.9589     0.8511     0.6225     0.4307     0.4736     0.7611     0.9593     0.9921     0.9973 (89)
MIT 2         19.3977    19.4996    19.7006    19.9972    20.2241    20.3160    20.3231    20.3248    20.2895    20.0464    19.6916    19.3869 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.5737 (91)
MIT           19.9346    20.0175    20.1819    20.4242    20.6189    20.7022    20.7109    20.7111    20.6760    20.4637    20.1716    19.9231 (92)
Temperature adjustment                                                                                                       0.0000
adjusted MIT  19.9346    20.0175    20.1819    20.4242    20.6189    20.7022    20.7109    20.7111    20.6760    20.4637    20.1716    19.9231 (93)

8. Space heating requirement

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9961     0.9941     0.9876     0.9609     0.8678     0.6600     0.4750     0.5193     0.7933     0.9623     0.9916     0.9969 (94)
Useful gains 330.8128   341.3014   347.5969   349.2020   323.3812   239.8369   164.1310   171.2724   249.4755   296.4778   309.9930   320.2085 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             652.6444   629.0423   567.4830   470.3064   362.7954   244.1534   164.4774   171.9144   264.8634   401.2242   535.1974   647.9529 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             239.4428   193.3619   163.5953    87.1952    29.3242     0.0000     0.0000     0.0000     0.0000    77.9314   162.1471   243.8418 (98)
Space heating                                                                                                             1196.8396 (98)
Space heating per m2                                                                                      (98) / (4) =   21.5259 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


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9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                0.0000 (301)
Fraction of space heat from community system                                         1.0000 (302)
Fraction of heat from community Boilers                                              1.0000 (303a)
Fraction of total space heat from community Boilers                                  1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating     1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating     1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                    1.0500 (306)
Space heating:
Annual space heating requirement                                                  1196.8396 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                               1256.6816 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                0.0000 (309)

Water heating
Annual water heating requirement                                                  1584.4432 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                               1663.6654 (310a)
Electricity used for heat distribution                                              29.2035 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                 89.0295 (330a)
Total electricity for the above, kWh/year                                           89.0295 (331)
Electricity for lighting (calculated in Appendix L)                                279.8198 (332)
Total delivered energy for all uses                                               3289.1962 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                     Energy   Emission factor       Emissions
                                                   kWh/year       kg CO2/kWh     kg CO2/year
Efficiency of heat source Boilers                                                    89.5000 (367a)
Space heating from Boilers                        3262.9575           0.2160        704.7988 (367)
Electrical energy for heat distribution             29.2035           0.5190         15.1566 (372)
Total CO2 associated with community systems                                        719.9554 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                            719.9554 (376)
Pumps and fans                                      89.0295           0.5190         46.2063 (378)
Energy for lighting                                279.8198           0.5190        145.2265 (379)
Total CO2, kg/year                                                                 911.3882 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                         16.3900 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                 16.3900 ZC1
Total Floor Area                                                           TFA      55.6000
Assumed number of occupants                                                  N       1.8549
CO2 emission factor in Table 12 for electricity displaced from grid         EF       0.5190
CO2 emissions from appliances, equation (L14)                                       17.2371 ZC2
CO2 emissions from cooking, equation (L16)                                           2.9410 ZC3
Total CO2 emissions                                                                 36.5680 ZC4
Residual CO2 emissions offset from biofuel CHP                                       0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                             0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation      0.0000 ZC7
Net CO2 emissions                                                                   36.5680 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                   Area        Storey height          Volume
                                                                   (m2)              (m)               (m3)
Ground floor                                                 55.6000 (1b)    x    2.5000 (2b)   =   139.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          55.6000                                  (4)
Dwelling volume                                                  (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   139.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                        main        secondary          other           total      m3 per hour
                                     heating          heating
Number of chimneys                         0    +           0    +         0    =       0 * 40 =      0.0000 (6a)
Number of open flues                       0    +           0    +         0    =       0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                             2 * 10 =     20.0000 (7a)
Number of passive vents                                                                 0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                            0 * 40 =      0.0000 (7c)

                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =        20.0000 / (5) =   0.1439 (8)
Pressure test                                                                                          Yes
Measured/design AP50                                                                                5.0000
Infiltration rate                                                                                   0.3939 (18)
Number of sides sheltered                                                                                3 (19)

Shelter factor                                                  (20) = 1 - [0.075 x (19)] =         0.7750 (20)
Infiltration rate adjusted to include shelter factor                 (21) = (18) x (20) =         0.3053 (21)


                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed      5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor     1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
                0.3892    0.3816    0.3739    0.3358    0.3282    0.2900    0.2900    0.2824    0.3053    0.3282    0.3434    0.3587 (22b)
Effective ac    0.5757    0.5728    0.5699    0.5564    0.5538    0.5420    0.5420    0.5399    0.5466    0.5538    0.5590    0.5643 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                   Gross    Openings     NetArea     U-value       A x U     K-value       A x K
                                             m2          m2          m2       W/m2K         W/K      kJ/m2K        kJ/K
TER Opaque door                                                  2.1200      1.0000      2.1200                        (26)
TER Opening Type (Uw = 1.40)                                     6.9800      1.3258      9.2538                        (27)
Exposed                                                         55.6000      0.1300      7.2280                        (28b)
External Wall                           17.5000      6.9800     10.5200      0.1800      1.8936                        (29a)
Wall to Stairwell                       17.5000      2.1200     15.3800      0.1800      2.7684                        (29a)
Total net area of external elements Aum(A, m2)                  90.6000                                                (31)
Fabric heat loss, W/K = Sum (A x U)                         (26)...(30) + (32) =   23.2638                             (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                        250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                 9.6435 (36)
Total fabric heat loss                                                                  (33) + (36) =     32.9073 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m         26.4093   26.2743   26.1421   25.5210   25.4048   24.8638   24.8638   24.7636   25.0722   25.4048   25.6399   25.8856 (38)
Heat transfer coeff
              59.3165   59.1816   59.0494   58.4283   58.3121   57.7711   57.7711   57.6709   57.9795   58.3121   58.5472   58.7929 (39)
Average = Sum(39)m / 12 =                                                                                          58.4277 (39)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP             1.0668    1.0644    1.0620    1.0509    1.0488    1.0390    1.0390    1.0372    1.0428    1.0488    1.0530    1.0574 (40)
HLP (average)                                                                                                      1.0509 (40)
Days in month
                    31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                  1.8549 (42)
Average daily hot water use (litres/day)                                                                          78.2543 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
              86.0797   82.9495   79.8194   76.6892   73.5590   70.4289   70.4289   73.5590   76.6892   79.8194   82.9495   86.0797 (44)
Energy conte 127.6537  111.6468  115.2095  100.4424   96.3769   83.1659   77.0654   88.4337   89.4899  104.2919  113.8427  123.6258 (45)
Energy content (annual)                                                                   Total = Sum(45)m =   1231.2445 (45)
Distribution loss  (46)m = 0.15 x (45)m
              19.1481   16.7470   17.2814   15.0664   14.4565   12.4749   11.5598   13.2651   13.4235   15.6438   17.0764   18.5439 (46)
Water storage loss:
Store volume                                                                                                       3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                      0.2602 (48)
  Temperature factor from Table 2b                                                                                 0.5400 (49)
Enter (49) or (54) in (55)                                                                                         0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	155.2714	136.5918	142.8271	127.1692	123.9945	109.8927	104.6831	116.0514	116.2167	131.9095	140.5695	151.2435	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	155.2714	136.5918	142.8271	127.1692	123.9945	109.8927	104.6831	116.0514	116.2167	131.9095	140.5695	151.2435	(64)
Total per year (kWh/year) = Sum(64)m =												1556.4204	(64)
Heat gains from water heating, kWh/month	64.5390	57.0785	60.4013	54.7785	54.1394	49.0341	47.7184	51.4984	51.1368	56.7712	59.2341	63.1997	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	92.7459	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8446	14.0730	11.4449	8.6645	6.4768	5.4680	5.9084	7.6800	10.3080	13.0884	15.2761	16.2849	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	161.7305	163.4087	159.1796	150.1762	138.8111	128.1295	120.9935	119.3152	123.5444	132.5478	143.9129	154.5945	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	32.2746	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	-74.1967	(71)
Water heating gains (Table 5)	86.7460	84.9383	81.1845	76.0813	72.7681	68.1029	64.1376	69.2182	71.0234	76.3053	82.2696	84.9459	(72)
Total internal gains	318.1448	316.2438	305.6328	288.7458	271.8798	255.5242	244.8633	250.0372	258.6995	275.7653	295.2824	309.6491	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9800	10.6334	0.6300	0.7000	0.7700	22.6829	(74)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	22.6829	43.3482	73.6592	118.3156	159.3820	170.6231	159.2985	126.3830	88.5623	51.6004	27.9823	18.9096	(83)
Total gains	340.8277	359.5920	379.2920	407.0614	431.2618	426.1473	404.1618	376.4202	347.2618	327.3657	323.2647	328.5587	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.0933	65.2417	65.3878	66.0829	66.2146	66.8347	66.8347	66.9508	66.5945	66.2146	65.9487	65.6731	
alpha	5.3396	5.3494	5.3592	5.4055	5.4143	5.4556	5.4556	5.4634	5.4396	5.4143	5.3966	5.3782	
util living area	0.9978	0.9966	0.9929	0.9779	0.9231	0.7794	0.6094	0.6704	0.8978	0.9833	0.9959	0.9982	(86)
MIT	19.8843	19.9800	20.1766	20.4686	20.7518	20.9352	20.9864	20.9777	20.8479	20.5104	20.1542	19.8665	(87)
Th 2	20.0280	20.0300	20.0320	20.0412	20.0429	20.0509	20.0509	20.0524	20.0478	20.0429	20.0394	20.0358	(88)
util rest of house	0.9971	0.9954	0.9902	0.9688	0.8902	0.6958	0.4879	0.5490	0.8418	0.9748	0.9942	0.9976	(89)
MIT 2	18.5381	18.6793	18.9672	19.3947	19.7843	20.0045	20.0455	20.0423	19.9152	19.4594	18.9409	18.5177	(90)
Living area fraction — fLA = Living area / (4) =												0.5737	(91)
MIT	19.3105	19.4255	19.6611	20.0108	20.3394	20.5385	20.5853	20.5790	20.4504	20.0624	19.6370	19.2915	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3105	19.4255	19.6611	20.0108	20.3394	20.5385	20.5853	20.5790	20.4504	20.0624	19.6370	19.2915	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9945	0.9889	0.9685	0.9017	0.7412	0.5580	0.6189	0.8683	0.9750	0.9933	0.9970	(94)
Useful gains	339.5769	357.6086	375.0926	394.2385	388.8534	315.8762	225.5105	232.9696	301.5354	319.1946	321.0881	327.5676	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	890.3692	859.6451	777.1566	649.1876	503.7821	343.0724	230.2349	241.0069	368.1901	551.7701	734.0067	887.2764	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	409.7895	337.3685	299.1356	183.5633	85.5070	0.0000	0.0000	0.0000	0.0000	173.0362	297.3014	416.4234	(98)
Space heating												2202.1248	(98)
Space heating per m2 — (98) / (4) =												39.6066	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2355.2136	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	409.7895	337.3685	299.1356	183.5633	85.5070	0.0000	0.0000	0.0000	0.0000	173.0362	297.3014	416.4234	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	438.2775	360.8219	319.9311	196.3244	91.4513	0.0000	0.0000	0.0000	0.0000	185.0654	317.9694	445.3726	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	155.2714	136.5918	142.8271	127.1692	123.9945	109.8927	104.6831	116.0514	116.2167	131.9095	140.5695	151.2435	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2840	87.1330	86.7413	85.7921	83.8461	79.8000	79.8000	79.8000	79.8000	85.5387	86.7652	87.3785	(217)
Fuel for water heating, kWh/month	177.8921	156.7624	164.6586	148.2294	147.8836	137.7101	131.1818	145.4278	145.6349	154.2104	162.0114	173.0901	(219)
Water heating fuel used												1844.6928	(219)

Annual totals kWh/year		
Space heating fuel - main system	2355.2136	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	279.8198	(232)
Total delivered energy for all uses	4554.7262	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2355.2136	0.2160	508.7261	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1844.6928	0.2160	398.4536	(264)
Space and water heating			907.1798	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	279.8198	0.5190	145.2265	(268)
Total CO2, kg/m2/year			1091.3312	(272)
Emissions per m2 for space and water heating			16.3162	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.6120	(272b)
Emissions per m2 for pumps and fans			0.7001	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3162 * 1.00) + 2.6120 + 0.7001, rounded to 2 d.p.			19.6300	(273)

Property Reference	002 Block D2-3B5P-03281	Issued on Date	22/07/2020
Assessment Reference	3B5P no cooling	Prop Type Ref	Exposed Floor
Property	002 Block D2-3B5P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	DER	14.32	TER	15.79
Environmental	89 B	% DER<TER	9.28		
CO_2 Emissions (t/year)	0.97	DFEE	40.85	TFEE	45.14
General Requirements Compliance	Pass	% DFEE<TFEE	9.50		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	Assessor ID	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 87 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.79 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.32 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)40.9 kWh/m²/yrOK
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element        Average                Highest
External wall  0.17 (max. 0.30)       0.18 (max. 0.70)         OK
Party wall     0.00 (max. 0.20)        -                       OK
Floor          0.10 (max. 0.25)       0.10 (max. 0.70)         OK
Roof           (no roof)
Openings       1.33 (max. 2.00)       1.40 (max. 3.30)         OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:       3.00 (design value)
Maximum                               10.0                                             OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                  Community heating scheme                         -

Secondary heating system:             None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                     Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                        OK
Primary pipework insulated:           No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:               Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                   No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                               75%                                              OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                   0.44
Maximum                               1.5                                              OK
MVHR efficiency:                      91%
Minimum:                              70%                                              OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):          Slight                                           OK
Based on:
Overshading:                          Average
Windows facing South East:            16.35 m², No overhang
Air change rate:                      2.00 ach
Blinds/curtains:                      None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                    0.00 W/m²K
Exposed floor U-value                 0.10 W/m²K
Door U-value                          0.82 W/m²K
Air permeability                      3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------
                                                                              Area          Storey height              Volume
                                                                              (m2)               (m)                    (m3)
Ground floor                                                               86.6000 (1b)    x      2.5000 (2b)    =    216.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          86.6000                                                        (4)
Dwelling volume                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    216.5000 (5)

-------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------
                                                         main          secondary             other              total       m3 per hour
                                                       heating          heating
Number of chimneys                                           0      +         0      +         0      =          0 * 40 =      0.0000 (6a)
Number of open flues                                         0      +         0      +         0      =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                      0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                          0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                     0 * 40 =      0.0000 (7c)

                                                                                                          Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                           0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                               Yes
Measured/design AP50                                                                                                     3.0000
Infiltration rate                                                                                                        0.1500 (18)
Number of sides sheltered                                                                                                     3 (19)

Shelter factor                                                                        (20) = 1 - [0.075 x (19)] =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                          (21) = (18) x (20) =      0.1163 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                               0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                            77.3500 (23c)

Effective ac    0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)

-------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------
Element                                          Gross       Openings        NetArea       U-value          A x U       K-value          A x K
                                                    m2             m2             m2        W/m2K            W/K        kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                              16.3500        1.3258        21.6761                          (27)
Door                                                                           2.1200        0.8200         1.7384                          (26)
Exposed                                                                       86.6000        0.1000         8.6600                          (28b)
External Wall                                  33.9000        16.3500        17.5500        0.1800         3.1590                          (29a)
Wall to Stairwell                              29.8500         2.1200        27.7300        0.1671         4.6328                          (29a)
Total net area of external elements Aum(A, m2)                               150.3500                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                 (26)...(30) + (32) =        39.8664                                 (33)
Party Wall 1                                                                  36.0000        0.0000         0.0000                          (32)
Party Ceilings 1                                                              86.6000                                                   (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                     250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                             12.8216 (36)
Total fabric heat loss                                                                            (33) + (36) =        52.6880 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          18.6806    18.4730    18.2654    17.2272    17.0195    15.9814    15.9814    15.7737    16.3966    17.0195    17.4348    17.8501 (38)
Heat transfer coeff
               71.3686    71.1610    70.9533    69.9151    69.7075    68.6693    68.6693    68.4617    69.0846    69.7075    70.1228    70.5380 (39)
Average = Sum(39)m / 12 =                                                                                               69.8632 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.8241     0.8217     0.8193     0.8073     0.8049     0.7929     0.7929     0.7906     0.7977     0.8049     0.8097     0.8145 (40)
HLP (average)                                                                                                           0.8067 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)

-------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                       2.5763 (42)
Average daily hot water use (litres/day)                                                                               95.3863 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              104.9249   101.1095    97.2940    93.4786    89.6631    85.8477    85.8477    89.6631    93.4786    97.2940   101.1095   104.9249 (44)
Energy conte  155.6006   136.0893   140.4320   122.4320   117.4764   101.3732    93.9372   107.7943   109.0817   127.1242   138.7660   150.6909 (45)
Energy content (annual)                                                                         Total = Sum(45)m =   1500.7977 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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                23.3401    20.4134    21.0648    18.3648    17.6215    15.2060    14.0906    16.1691    16.3623    19.0686    20.8149    22.6036 (46)
Water storage loss:
Store volume                                                                                                            3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                            0.0212 (51)
  Volume factor from Table 2a                                                                                           3.4200 (52)
  Temperature factor from Table 2b                                                                                      1.0000 (53)
Enter (49) or (54) in (55)                                                                                              0.2173 (55)
Total storage loss
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               185.5983   163.1840   170.4297   151.4620   147.4741   130.4032   123.9349   137.7920   138.1117   157.1219   167.7960   180.6886 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               185.5983   163.1840   170.4297   151.4620   147.4741   130.4032   123.9349   137.7920   138.1117   157.1219   167.7960   180.6886 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =   1853.9964 (64)
Heat gains from water heating, kWh/month
                75.7354    66.9254    70.6918    63.9327    63.0591    56.9306    55.2323    59.8398    59.4937    66.2670    69.3637    74.1029 (65)

-------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132   128.8132 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                21.0367    18.6846    15.1953    11.5038     8.5993     7.2599     7.8445    10.1966    13.6859    17.3774    20.2820    21.6214 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               232.6818   235.0963   229.0118   216.0586   199.7076   184.3400   174.0734   171.6589   177.7434   190.6965   207.0476   222.4152 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813    35.8813 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506  -103.0506 (71)
Water heating gains (Table 5)
               101.7948    99.5914    95.0158    88.7954    84.7568    79.0703    74.2369    80.4298    82.6301    89.0685    96.3385    99.6006 (72)
Total internal gains
               417.1572   415.0163   400.8669   378.0018   354.7076   332.3141   317.7988   323.9293   335.7034   358.7864   385.3120   405.2812 (73)

-------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------
[Jan]                                   Area      Solar flux              g               FF          Access           Gains
                                          m2        Table 6a   Specific data   Specific data          factor               W
                                                        W/m2     or Table 6b     or Table 6c        Table 6d
-------------------------------------------------------------------------------------------
Southeast                            16.3500         36.7938          0.4000          0.7000          0.7700        116.7304 (77)
-------------------------------------------------------------------------------------------

Solar gains    116.7304   198.8351   272.0548   337.0891   377.5679   374.8376   361.3834   331.1844   294.5779   219.7551   139.8161    99.8969 (83)
Total gains    533.8877   613.8514   672.9218   715.0909   732.2756   707.1516   679.1823   655.1137   630.2812   578.5415   525.1281   505.1781 (84)

-------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                            21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            84.2652    84.5111    84.7584    86.0170    86.2732    87.5775    87.5775    87.8431    87.0511    86.2732    85.7623    85.2574
alpha           6.6177     6.6341     6.6506     6.7345     6.7515     6.8385     6.8385     6.8562     6.8034     6.7515     6.7175     6.6838
util living area
                0.9973     0.9925     0.9786     0.9314     0.8123     0.6122     0.4439     0.4791     0.7252     0.9467     0.9927     0.9981 (86)

MIT            20.2397    20.3813    20.5727    20.7919    20.9381    20.9924    20.9992    20.9987    20.9773    20.7949    20.4758    20.2136 (87)
Th 2           20.2325    20.2345    20.2366    20.2470    20.2491    20.2594    20.2594    20.2615    20.2553    20.2491    20.2449    20.2408 (88)
util rest of house
                0.9964     0.9903     0.9720     0.9112     0.7665     0.5454     0.3697     0.4031     0.6589     0.9266     0.9900     0.9975 (89)
MIT 2          19.2107    19.4180    19.6948    20.0069    20.1904    20.2544    20.2591    20.2610    20.2384    20.0176    19.5644    19.1790 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.4031 (91)
MIT            19.6255    19.8063    20.0487    20.3233    20.4918    20.5519    20.5575    20.5584    20.5362    20.3310    19.9318    19.5961 (92)
Temperature adjustment                                                                                                   0.0000
adjusted MIT   19.6255    19.8063    20.0487    20.3233    20.4918    20.5519    20.5575    20.5584    20.5362    20.3310    19.9318    19.5961 (93)

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8. Space heating requirement
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                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9955     0.9886     0.9701     0.9135     0.7821     0.5722     0.3997     0.4338     0.6848     0.9291     0.9886     0.9968 (94)
Useful gains  531.5041   606.8776   652.7747   653.2367   572.7124   404.5972   271.4476   284.1589   431.5894   537.5257   519.1642   503.5516 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1093.7614  1060.7463   961.3243   798.6642   612.8555   408.7134   271.7581   284.6908   444.6452   678.3205   899.8027  1086.0101 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              418.3194   304.9998   229.5609   104.7078    29.8664     0.0000     0.0000     0.0000     0.0000   104.7514   274.0597   433.3491 (98)
Space heating                                                                                                         1899.6146 (98)
Space heating per m2                                                                                   (98) / (4) =     21.9355 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
Not applicable

9b. Energy requirements
Fraction of space heat from secondary/supplementary system (Table 11)             0.0000 (301)
Fraction of space heat from community system                                       1.0000 (302)
Fraction of heat from community Boilers                                            1.0000 (303a)
Fraction of total space heat from community Boilers                                1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating   1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating   1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                  1.0500 (306)
Space heating:
Annual space heating requirement                                                1899.6146 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                             1994.5953 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                              0.0000 (309)

Water heating
Annual water heating requirement                                                1853.9964 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                             1946.6962 (310a)
Electricity used for heat distribution                                            39.4129 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
   mechanical ventilation fans (SFP =       0.5500)                              145.2715 (330a)
Total electricity for the above, kWh/year                                        145.2715 (331)
Electricity for lighting (calculated in Appendix L)                              371.5144 (332)
Total delivered energy for all uses                                             4458.0774 (338)

12b. Carbon dioxide emissions - Community heating scheme
                                                 Energy    Emission factor      Emissions
                                               kWh/year        kg CO2/kWh     kg CO2/year
Efficiency of heat source Boilers                                               89.5000 (367a)
Space heating from Boilers                    4403.6777            0.2160      951.1944 (367)
Electrical energy for heat distribution         39.4129            0.5190       20.4553 (372)
Total CO2 associated with community systems                                    971.6497 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                        971.6497 (376)
Pumps and fans                                 145.2715            0.5190       75.3959 (378)
Energy for lighting                            371.5144            0.5190      192.8160 (379)
Total CO2, kg/year                                                            1239.8615 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                     14.3200 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                             14.3200 ZC1
Total Floor Area                                                        TFA     86.6000
Assumed number of occupants                                               N      2.5763
CO2 emission factor in Table 12 for electricity displaced from grid      EF      0.5190
CO2 emissions from appliances, equation (L14)                                   15.9217 ZC2
CO2 emissions from cooking, equation (L16)                                       2.0881 ZC3
Total CO2 emissions                                                             32.3299 ZC4
Residual CO2 emissions offset from biofuel CHP                                   0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                         0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation  0.0000 ZC7
Net CO2 emissions                                                               32.3299 ZC8
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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014

1. Overall dwelling dimensions
                                                          Area       Storey height          Volume
                                                          (m2)                 (m)            (m3)
Ground floor                                       86.6000 (1b)   x    2.5000 (2b)   =   216.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)     86.6000                                    (4)
Dwelling volume                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   216.5000 (5)

2. Ventilation rate
                                    main       secondary        other          total      m3 per hour
                                 heating         heating
Number of chimneys                     0    +          0    +       0    =      0 * 40 =     0.0000 (6a)
Number of open flues                   0    +          0    +       0    =      0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                     3 * 10 =    30.0000 (7a)
Number of passive vents                                                         0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                    0 * 40 =     0.0000 (7c)

                                                                                Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =       30.0000 / (5) =     0.1386 (8)
Pressure test                                                                                          Yes
Measured/design AP50                                                                                5.0000
Infiltration rate                                                                                   0.3886 (18)
Number of sides sheltered                                                                                3 (19)

Shelter factor                                              (20) = 1 - [0.075 x (19)] =             0.7750 (20)
Infiltration rate adjusted to include shelter factor              (21) = (18) x (20) =             0.3011 (21)

                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed   5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor  1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
             0.3840   0.3764   0.3689   0.3313   0.3237   0.2861   0.2861   0.2786   0.3011   0.3237   0.3388   0.3538 (22b)
Effective ac 0.5737   0.5708   0.5680   0.5549   0.5524   0.5409   0.5409   0.5388   0.5453   0.5524   0.5574   0.5626 (25)

3. Heat losses and heat loss parameter
Element                              Gross   Openings    NetArea    U-value      A x U    K-value      A x K
                                        m2         m2         m2      W/m2K        W/K    kJ/m2K       kJ/K
TER Opaque door                                            2.1200     1.0000     2.1200                    (26)
TER Opening Type (Uw = 1.40)                              16.3500     1.3258    21.6761                    (27)
Exposed                                                   86.6000     0.1300    11.2580                    (28b)
External Wall                      33.9000    16.3500    17.5500     0.1800     3.1590                    (29a)
Wall to Stairwell                  29.8500     2.1200    27.7300     0.1800     4.9914                    (29a)
Total net area of external elements Aum(A, m2)           150.3500                                          (31)
Fabric heat loss, W/K = Sum (A x U)                  (26)...(30) + (32) =    43.2045                    (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                             250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                     12.1385 (36)
Total fabric heat loss                                                          (33) + (36) =  55.3430 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m       40.9887  40.7842  40.5838  39.6423  39.4662  38.6462  38.6462  38.4943  38.9620  39.4662  39.8225  40.1951 (38)
Heat transfer coeff
            96.3318  96.1273  95.9268  94.9853  94.8092  93.9892  93.9892  93.8373  94.3050  94.8092  95.1655  95.5381 (39)
Average = Sum(39)m / 12 =                                                                              94.9845 (39)

                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP          1.1124   1.1100   1.1077   1.0968   1.0948   1.0853   1.0853   1.0836   1.0890   1.0948   1.0989   1.1032 (40)
HLP (average)                                                                                           1.0968 (40)
Days in month
                 31       28       31       30       31       30       31       31       30       31       30       31 (41)

4. Water heating energy requirements (kWh/year)
Assumed occupancy                                                                                       2.5763 (42)
Average daily hot water use (litres/day)                                                               95.3863 (43)

                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
           104.9249 101.1095  97.2940  93.4786  89.6631  85.8477  85.8477  89.6631  93.4786  97.2940 101.1095 104.9249 (44)
Energy conte 155.6006 136.0893 140.4320 122.4320 117.4764 101.3732 93.9372 107.7943 109.0817 127.1242 138.7660 150.6909 (45)
Energy content (annual)                                                          Total = Sum(45)m =  1500.7977 (45)
Distribution loss  (46)m = 0.15 x (45)m
            23.3401  20.4134  21.0648  18.3648  17.6215  15.2060  14.0906  16.1691  16.3623  19.0686  20.8149  22.6036 (46)
Water storage loss:
Store volume                                                                                            3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                           0.2602 (48)
  Temperature factor from Table 2b                                                                      0.5400 (49)
Enter (49) or (54) in (55)                                                                              0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	183.2183	161.0343	168.0496	149.1588	145.0941	128.1000	121.5549	135.4120	135.8085	154.7419	165.4928	178.3086	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	183.2183	161.0343	168.0496	149.1588	145.0941	128.1000	121.5549	135.4120	135.8085	154.7419	165.4928	178.3086	(64)
Total per year (kWh/year) = Sum(64)m =												1825.9736	(64)
Heat gains from water heating, kWh/month	73.8313	65.2057	68.7878	62.0901	61.1550	55.0880	53.3283	57.9357	57.6511	64.3629	67.5211	72.1989	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	128.8132	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0367	18.6846	15.1953	11.5038	8.5993	7.2599	7.8445	10.1966	13.6859	17.3774	20.2820	21.6214	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.6818	235.0963	229.0118	216.0586	199.7076	184.3400	174.0734	171.6589	177.7434	190.6965	207.0476	222.4152	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	35.8813	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	-103.0506	(71)
Water heating gains (Table 5)	99.2357	97.0323	92.4567	86.2362	82.1976	76.5111	71.6778	77.8706	80.0710	86.5093	93.7793	97.0415	(72)
Total internal gains	417.5981	415.4571	401.3078	378.4426	355.1485	332.7549	318.2397	324.3701	336.1442	359.2272	385.7528	405.7220	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	16.3500	36.7938	0.6300	0.7000	0.7700	183.8504	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	183.8504	313.1653	428.4864	530.9154	594.6695	590.3692	569.1789	521.6155	463.9601	346.1143	220.2104	157.3376	(83)
Total gains	601.4485	728.6224	829.7941	909.3580	949.8180	923.1241	887.4185	845.9856	800.1043	705.3415	605.9632	563.0597	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.4289	62.5617	62.6925	63.3139	63.4315	63.9849	63.9849	64.0884	63.7706	63.4315	63.1940	62.9476	
alpha	5.1619	5.1708	5.1795	5.2209	5.2288	5.2657	5.2657	5.2726	5.2514	5.2288	5.2129	5.1965	
util living area	0.9961	0.9891	0.9710	0.9199	0.8067	0.6261	0.4615	0.5029	0.7426	0.9436	0.9907	0.9972	(86)
MIT	19.8975	20.0966	20.3604	20.6574	20.8734	20.9741	20.9956	20.9932	20.9379	20.6490	20.2091	19.8585	(87)
Th 2	19.9907	19.9927	19.9945	20.0034	20.0051	20.0128	20.0128	20.0143	20.0098	20.0051	20.0017	19.9982	(88)
util rest of house	0.9948	0.9857	0.9617	0.8945	0.7518	0.5401	0.3604	0.3990	0.6612	0.9201	0.9871	0.9963	(89)
MIT 2	18.5302	18.8204	19.1998	19.6165	19.8875	19.9965	20.0113	20.0116	19.9644	19.6157	18.9922	18.4789	(90)
Living area fraction									fLA = Living area / (4) =			0.4031	(91)
MIT	19.0814	19.3349	19.6677	20.0361	20.2849	20.3906	20.4081	20.4073	20.3569	20.0322	19.4827	19.0350	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0814	19.3349	19.6677	20.0361	20.2849	20.3906	20.4081	20.4073	20.3569	20.0322	19.4827	19.0350	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9932	0.9827	0.9579	0.8955	0.7684	0.5740	0.4013	0.4410	0.6915	0.9209	0.9846	0.9950	(94)
Useful gains	597.3658	716.0106	794.8928	814.2945	729.8484	529.9017	356.1219	373.1127	553.2735	649.5301	596.6274	560.2493	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1423.9191	1387.5846	1263.1334	1057.7676	813.9311	544.2543	357.9188	376.0366	590.0550	894.2602	1178.4109	1417.3122	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	614.9556	451.2977	348.3709	175.3007	62.5576	0.0000	0.0000	0.0000	0.0000	182.0792	418.8841	637.6548	(98)
Space heating												2891.1006	(98)
Space heating per m2											(98) / (4) =	33.3845	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3092.0862	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.9556	451.2977	348.3709	175.3007	62.5576	0.0000	0.0000	0.0000	0.0000	182.0792	418.8841	637.6548	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	657.7066	482.6714	372.5892	187.4873	66.9065	0.0000	0.0000	0.0000	0.0000	194.7371	448.0044	681.9837	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	183.2183	161.0343	168.0496	149.1588	145.0941	128.1000	121.5549	135.4120	135.8085	154.7419	165.4928	178.3086	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7977	87.4174	86.7163	85.2454	82.7474	79.8000	79.8000	79.8000	79.8000	85.2486	87.1892	87.9237	(217)
Fuel for water heating, kWh/month	208.6824	184.2130	193.7924	174.9758	175.3459	160.5263	152.3244	169.6892	170.1861	181.5184	189.8088	202.7991	(219)
Water heating fuel used												2163.8616	(219)

Annual totals kWh/year		
Space heating fuel - main system	3092.0862	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	371.5144	(232)
Total delivered energy for all uses	5702.4621	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3092.0862	0.2160	667.8906	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2163.8616	0.2160	467.3941	(264)
Space and water heating			1135.2847	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.5144	0.5190	192.8160	(268)
Total CO2, kg/m2/year			1367.0257	(272)
Emissions per m2 for space and water heating			13.1095	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2265	(272b)
Emissions per m2 for pumps and fans			0.4495	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.1095 * 1.00) + 2.2265 + 0.4495, rounded to 2 d.p.			15.7900	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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Property Reference	003 Block E1-1B1P-03281	**Issued on Date**	22/07/2020
Assessment Reference	1B1P no cooling	**Prop Type Ref**	Middle floor
Property	003 Block E1-1B1P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	82 B	**DER**	21.88	**TER**	24.16
Environmental	88 B	**% DER<TER**	9.44		
CO_2 Emissions (t/year)	0.71	**DFEE**	59.39	**TFEE**	56.20
General Requirements Compliance	Fail	**% DFEE<TFEE**	-5.68		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 40 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 24.16 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 21.88 kgCO□/m²OK
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1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)59.4 kWh/m²/yrFail
Excess energy =3.2 kWh/m²/yr  (5.7%)
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.32 (max. 2.00)       1.40 (max. 3.30)          OK
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2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                                  OK
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4 Heating efficiency
Main heating system:                   Community heating scheme                              -

Secondary heating system:              None
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5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:            No primary pipework
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6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                    No cylinderstat


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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                                   OK
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8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.42
Maximum                                1.5                                                   OK
MVHR efficiency:                       91%
Minimum:                               70%                                                   OK
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9 Summertime temperature
Overheating risk (Midlands):           Medium                                                OK
Based on:
Overshading:                           Average
Windows facing North East:             2.55 m², No overhang
Windows facing North West:             10.75 m², No overhang
Air change rate:                       2.00 ach
Blinds/curtains:                       None
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10 Key features
Party wall U-value                     0.00 W/m²K
Door U-value                           0.82 W/m²K
Air permeability                       3.0 m³/m²h



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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE     09 Jan 2014
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--------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
--------------------------------------------------------------------------------------------
                                                                   Area        Storey height          Volume
                                                                   (m2)             (m)                (m3)
Ground floor                                                    40.3000 (1b)    x    2.5000 (2b)   =  100.7500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)       40.3000                                           (4)
Dwelling volume                                                      (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =  100.7500 (5)

--------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------
                                                 main         secondary          other            total       m3 per hour
                                               heating         heating
Number of chimneys                                0     +         0      +         0      =       0 * 40 =      0.0000 (6a)
Number of open flues                              0     +         0      +         0      =       0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                       0 * 10 =      0.0000 (7a)
Number of passive vents                                                                           0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                      0 * 40 =      0.0000 (7c)

                                                                                              Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                  0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                    Yes
Measured/design AP50                                                                                          3.0000
Infiltration rate                                                                                             0.1500 (18)
Number of sides sheltered                                                                                          3 (19)

Shelter factor                                                                   (20) = 1 - [0.075 x (19)] =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                (21) = (18) x (20) =         0.1163 (21)

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed      5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor     1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
                0.1482   0.1453   0.1424   0.1279   0.1250   0.1104   0.1104   0.1075   0.1163   0.1250   0.1308   0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                    0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                 77.3500 (23c)

Effective ac    0.2615   0.2586   0.2557   0.2411   0.2382   0.2237   0.2237   0.2208   0.2295   0.2382   0.2440   0.2498 (25)

--------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
--------------------------------------------------------------------------------------------
Element                                      Gross     Openings     NetArea     U-value      A x U     K-value      A x K
                                               m2          m2          m2       W/m2K        W/K      kJ/m2K       kJ/K
Window Double-Glazed (Uw = 1.40)                                   13.3000      1.3258    17.6326                          (27)
Door                                                                2.1200      0.8200     1.7384                          (26)
External Wall                               22.8300     13.3000     9.5300      0.1800     1.7154                          (29a)
Wall to CA                                  40.7500      2.1200    38.6300      0.1671     6.4539                          (29a)
Total net area of external elements Aum(A, m2)                     63.5800                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =  27.5402                         (33)
Party Wall 1                                                       14.0500      0.0000     0.0000                          (32)
Party Floor 1                                                      40.3000                                                 (32d)
Party Ceilings 1                                                   40.3000                                                 (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                           250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                    8.4248 (36)
Total fabric heat loss                                                                     (33) + (36) =     35.9650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m           8.6932   8.5966   8.4999   8.0168   7.9202   7.4371   7.4371   7.3404   7.6303   7.9202   8.1134   8.3067 (38)
Heat transfer coeff
               44.6582  44.5616  44.4650  43.9818  43.8852  43.4021  43.4021  43.3055  43.5953  43.8852  44.0785  44.2717 (39)
Average = Sum(39)m / 12 =                                                                                    43.9577 (39)

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP             1.1081   1.1057   1.1033   1.0914   1.0890   1.0770   1.0770   1.0746   1.0818   1.0890   1.0938   1.0986 (40)
HLP (average)                                                                                                 1.0908 (40)
Days in month
                    31       28       31       30       31       30       31       31       30       31       30       31 (41)

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4. Water heating energy requirements (kWh/year)
--------------------------------------------------------------------------------------------
Assumed occupancy                                                                                             1.4143 (42)
Average daily hot water use (litres/day)                                                                     67.7904 (43)

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
               74.5694  71.8578  69.1462  66.4346  63.7230  61.0113  61.0113  63.7230  66.4346  69.1462  71.8578  74.5694 (44)
Energy conte  110.5843  96.7177  99.8040  87.0116  83.4897  72.0452  66.7605  76.6087  77.5236  90.3463  98.6201 107.0950 (45)
Energy content (annual)                                                                     Total = Sum(45)m =  1066.6067 (45)
Distribution loss  (46)m = 0.15 x (45)m
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               16.5876  14.5077  14.9706  13.0517  12.5235  10.8068  10.0141  11.4913  11.6285  13.5519  14.7930  16.0642 (46)
Water storage loss:
Store volume                                                                                                  3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                  0.0212 (51)
  Volume factor from Table 2a                                                                                 3.4200 (52)
  Temperature factor from Table 2b                                                                            1.0000 (53)
Enter (49) or (54) in (55)                                                                                    0.2173 (55)
Total storage loss
                6.7353   6.0835   6.7353   6.5180   6.7353   6.5180   6.7353   6.7353   6.5180   6.7353   6.5180   6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353   6.0835   6.7353   6.5180   6.7353   6.5180   6.7353   6.7353   6.5180   6.7353   6.5180   6.7353 (57)
Primary loss   23.2624  21.0112  23.2624  22.5120  23.2624  22.5120  23.2624  23.2624  22.5120  23.2624  22.5120  23.2624 (59)
Total heat required for water heating calculated for each month
              140.5820 123.8124 129.8017 116.0416 113.4874 101.0753  96.7582 106.6064 106.5536 120.3440 127.6501 137.0927 (62)
Solar input     0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 (63)
                                                                          Solar input (sum of months) = Sum(63)m =   0.0000 (63)
Output from w/h
              140.5820 123.8124 129.8017 116.0416 113.4874 101.0753  96.7582 106.6064 106.5536 120.3440 127.6501 137.0927 (64)
                                                                           Total per year (kWh/year) = Sum(64)m = 1419.8054 (64)
Heat gains from water heating, kWh/month
               60.7674  53.8344  57.1830  52.1554  51.7585  47.1791  46.1960  49.4705  49.0006  54.0383  56.0152  59.6072 (65)

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5. Internal gains (see Table 5 and 5a)
--------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(66)m          70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166  70.7166 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               10.9021   9.6832   7.8749   5.9618   4.4565   3.7624   4.0654   5.2843   7.0926   9.0057  10.5110  11.2051 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              122.2887 123.5576 120.3599 113.5522 104.9587  96.8821  91.4864  90.2174  93.4152 100.2228 108.8163 116.8930 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717  30.0717 (69)
Pumps, fans     0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 -56.5733 (71)
Water heating gains (Table 5)
               81.6767  80.1107  76.8589  72.4380  69.5678  65.5265  62.0914  66.4927  68.0564  72.6321  77.7989  80.1173 (72)
Total internal gains
              259.0824 257.5665 249.3086 236.1670 223.1980 210.3859 201.8581 206.2094 212.7792 226.0756 241.3412 252.4303 (73)

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6. Solar gains
--------------------------------------------------------------------------------------------
[Jan]                                  Area      Solar flux            g              FF           Access          Gains
                                         m2        Table 6a    Specific data   Specific data       factor              W
                                                      W/m2      or Table 6b     or Table 6c      Table 6d
--------------------------------------------------------------------------------------------
Northeast                            2.5500         11.2829          0.4000          0.7000        0.7700         5.5828 (75)
Northwest                           10.7500         11.2829          0.4000          0.7000        0.7700        23.5354 (81)
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Solar gains    29.1182  59.2710 106.7876 175.3758 235.7395 251.3233 235.1078 187.4307 130.1223  72.4339  36.6383  23.7794 (83)
Total gains   288.2007 316.8375 356.0961 411.5428 458.9376 461.7092 436.9659 393.6400 342.9015 298.5096 277.9794 276.2098 (84)

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7. Mean internal temperature (heating season)
--------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
tau            62.6673  62.8032  62.9397  63.6310  63.7711  64.4810  64.4810  64.6249  64.1952  63.7711  63.4916  63.2144
alpha           5.1778   5.1869   5.1960   5.2421   5.2514   5.2987   5.2987   5.3083   5.2797   5.2514   5.2328   5.2143
util living area
                0.9955   0.9919   0.9790   0.9263   0.7870   0.5847   0.4340   0.4992   0.7810   0.9600   0.9912   0.9964 (86)

MIT            19.9224  20.0528  20.3040  20.6444  20.8894  20.9816  20.9968  20.9937  20.9222  20.5997  20.2061  19.8978 (87)
Th 2           19.9942  19.9961  19.9981  20.0079  20.0099  20.0197  20.0197  20.0216  20.0157  20.0099  20.0059  20.0020 (88)
util rest of house
                0.9941   0.9892   0.9719   0.9024   0.7306   0.5024   0.3389   0.3966   0.7024   0.9420   0.9878   0.9952 (89)
MIT 2          18.5689  18.7599  19.1234  19.6037  19.9085  20.0083  20.0186  20.0192  19.9568  19.5550  18.9911  18.5387 (90)
Living area fraction                                                                 fLA = Living area / (4) =   0.7983 (91)
MIT            19.6494  19.7920  20.0658  20.4344  20.6915  20.7852  20.7995  20.7971  20.7274  20.3890  19.9610  19.6236 (92)
Temperature adjustment                                                                                        0.0000
adjusted MIT   19.6494  19.7920  20.0658  20.4344  20.6915  20.7852  20.7995  20.7971  20.7274  20.3890  19.9610  19.6236 (93)

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8. Space heating requirement
--------------------------------------------------------------------------------------------

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Utilisation     0.9934   0.9886   0.9725   0.9135   0.7706   0.5672   0.4147   0.4784   0.7611   0.9497   0.9876   0.9947 (94)
Useful gains  286.3107 313.2227 346.2888 375.9537 353.6380 261.8856 181.2286 188.3141 260.9810 283.5029 274.5364 274.7371 (95)
Ext temp.       4.3000   4.9000   6.5000   8.9000  11.7000  14.6000  16.6000  16.4000  14.1000  10.6000   7.1000   4.2000 (96)
Heat loss rate W
              685.4748 663.6102 603.2032 507.3047 394.5932 268.4512 182.2659 190.4171 288.9242 429.5917 566.8942 682.8289 (97)
Month fracti    1.0000   1.0000   1.0000   1.0000   1.0000   0.0000   0.0000   0.0000   0.0000   1.0000   1.0000   1.0000 (97a)
Space heating kWh
              296.9781 235.4604 191.1443  94.5727  30.4707   0.0000   0.0000   0.0000   0.0000 108.6900 210.4976 303.6203 (98)
Space heating                                                                                              1471.4342 (98)
Space heating per m2                                                                         (98) / (4) =   36.5120 (99)
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
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Not applicable


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9b. Energy requirements
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Fraction of space heat from secondary/supplementary system (Table 11)                           0.0000 (301)
Fraction of space heat from community system                                                    1.0000 (302)
Fraction of heat from community Boilers                                                         1.0000 (303a)
Fraction of total space heat from community Boilers                                             1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                               1.0500 (306)
Space heating:
Annual space heating requirement                                                              1471.4342 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                           1545.0059 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)          0.0000 (308)
Space heating fuel for secondary/supplementary system                                           0.0000 (309)

Water heating
Annual water heating requirement                                                              1419.8054 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                           1490.7957 (310a)
Electricity used for heat distribution                                                          30.3580 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                             64.5304 (330a)
Total electricity for the above, kWh/year                                                       64.5304 (331)
Electricity for lighting (calculated in Appendix L)                                            192.5349 (332)
Total delivered energy for all uses                                                           3292.8668 (338)


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12b. Carbon dioxide emissions - Community heating scheme
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                                                                 Energy      Emission factor         Emissions
                                                              kWh/year          kg CO2/kWh         kg CO2/year
Efficiency of heat source Boilers                                                                 89.5000 (367a)
Space heating from Boilers                                   3391.9570              0.2160          732.6627 (367)
Electrical energy for heat distribution                        30.3580              0.5190           15.7558 (372)
Total CO2 associated with community systems                                                       748.4185 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                           748.4185 (376)
Pumps and fans                                                 64.5304              0.5190           33.4913 (378)
Energy for lighting                                           192.5349              0.5190           99.9256 (379)
Total CO2, kg/year                                                                                881.8354 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                        21.8800 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                21.8800 ZC1
Total Floor Area                                                                          TFA      40.3000
Assumed number of occupants                                                                 N       1.4143
CO2 emission factor in Table 12 for electricity displaced from grid                        EF       0.5190
CO2 emissions from appliances, equation (L14)                                                      17.9816 ZC2
CO2 emissions from cooking, equation (L16)                                                          3.7951 ZC3
Total CO2 emissions                                                                                43.6567 ZC4
Residual CO2 emissions offset from biofuel CHP                                                      0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                            0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                     0.0000 ZC7
Net CO2 emissions                                                                                  43.6567 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                      Area         Storey height              Volume
                                                                      (m2)                   (m)                (m3)
Ground floor                                                       40.3000 (1b)    x       2.5000 (2b)    =   100.7500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            40.3000                                      (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   100.7500 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                     main          secondary          other            total        m3 per hour
                                                  heating            heating
Number of chimneys                                      0      +           0      +       0      =         0 * 40 =      0.0000 (6a)
Number of open flues                                    0      +           0      +       0      =         0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                2 * 10 =     20.0000 (7a)
Number of passive vents                                                                                    0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                               0 * 40 =      0.0000 (7c)

                                                                                                      Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                        20.0000 / (5) =   0.1985 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                5.0000
Infiltration rate                                                                                                   0.4485 (18)
Number of sides sheltered                                                                                                3 (19)

Shelter factor                                                                   (20) = 1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                    (21) = (18) x (20)  =     0.3476 (21)


                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed   5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor  1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
             0.4432    0.4345    0.4258    0.3824    0.3737    0.3302    0.3302    0.3215    0.3476    0.3737    0.3910    0.4084 (22b)
Effective ac 0.5982    0.5944    0.5907    0.5731    0.5698    0.5545    0.5545    0.5517    0.5604    0.5698    0.5765    0.5834 (25)


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3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                        Gross     Openings      NetArea     U-value        A x U     K-value        A x K
                                                  m2           m2           m2       W/m2K          W/K      kJ/m2K         kJ/K
TER Opaque door                                                         2.1200      1.0000       2.1200                          (26)
TER Opening Type (Uw = 1.40)                                            7.9600      1.3258      10.5530                          (27)
External Wall                                22.8300       7.9600      14.8700      0.1800       2.6766                          (29a)
Wall to CA                                   40.7500       2.1200      38.6300      0.1800       6.9534                          (29a)
Total net area of external elements Aum(A, m2)                         63.5800                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                 (26)...(30) + (32) =      22.3030                          (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                         5.3077 (36)
Total fabric heat loss                                                                         (33) + (36) =      27.6107 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m       19.8889   19.7621   19.6378   19.0541   18.9449   18.4365   18.4365   18.3423   18.6323   18.9449   19.1658   19.3968 (38)
Heat transfer coeff
            47.4996   47.3728   47.2485   46.6648   46.5556   46.0472   46.0472   45.9530   46.2430   46.5556   46.7765   47.0075 (39)
Average = Sum(39)m / 12 =                                                                                         46.6643 (39)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP          1.1787    1.1755    1.1724    1.1579    1.1552    1.1426    1.1426    1.1403    1.1475    1.1552    1.1607    1.1664 (40)
HLP (average)                                                                                                      1.1579 (40)
Days in month
                 31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                  1.4143 (42)
Average daily hot water use (litres/day)                                                                          67.7904 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
            74.5694   71.8578   69.1462   66.4346   63.7230   61.0113   61.0113   63.7230   66.4346   69.1462   71.8578   74.5694 (44)
Energy conte 110.5843 96.7177   99.8040   87.0116   83.4897   72.0452   66.7605   76.6087   77.5236   90.3463   98.6201  107.0950 (45)
Energy content (annual)                                                                     Total = Sum(45)m =   1066.6067 (45)
Distribution loss  (46)m = 0.15 x (45)m
            16.5876   14.5077   14.9706   13.0517   12.5235   10.8068   10.0141   11.4913   11.6285   13.5519   14.7930   16.0642 (46)
Water storage loss:
Store volume                                                                                                       3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                      0.2602 (48)
  Temperature factor from Table 2b                                                                                 0.5400 (49)
Enter (49) or (54) in (55)                                                                                         0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
              4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
              4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss 23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
            138.2020  121.6627  127.4217  113.7384  111.1074   98.7720   94.3782  104.2263  104.2504  117.9640  125.3468  134.7127 (62)
Solar input   0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                              Solar input (sum of months) = Sum(63)m =    0.0000 (63)
Output from w/h
            138.2020  121.6627  127.4217  113.7384  111.1074   98.7720   94.3782  104.2263  104.2504  117.9640  125.3468  134.7127 (64)
                                                                                Total per year (kWh/year) = Sum(64)m = 1391.7826 (64)
Heat gains from water heating, kWh/month
             58.8634   52.1146   55.2790   50.3128   49.8545   45.3365   44.2920   47.5665   47.1580   52.1343   54.1726   57.7032 (65)
```

```
-----------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
             10.9938    9.7646    7.9411    6.0119    4.4940    3.7940    4.0996    5.3288    7.1522    9.0814   10.5993   11.2993 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
            122.2887  123.5576  120.3599  113.5522  104.9587   96.8821   91.4864   90.2174   93.4152  100.2228  108.8163  116.8930 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
             30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717 (69)
Pumps, fans   3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733 (71)
Water heating gains (Table 5)
             79.1175   77.5516   74.2997   69.8789   67.0087   62.9673   59.5323   63.9335   65.4973   70.0730   75.2397   77.5581 (72)
Total internal gains
            259.6149  258.0887  249.8156  236.6579  223.6763  210.8584  202.3332  206.6946  213.2796  226.5922  241.8703  252.9654 (73)
```

```
-----------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------

[Jan]                                  Area      Solar flux              g             FF          Access            Gains
                                         m2        Table 6a   Specific data  Specific data          factor                W
                                                       W/m2     or Table 6b    or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------
Northeast                            1.5300         11.2829          0.6300         0.7000          0.7700           5.2758 (75)
Northwest                            6.4300         11.2829          0.6300         0.7000          0.7700          22.1720 (81)
-----------------------------------------------------------------------------------------------

Solar gains  27.4478   55.8707  100.6613  165.3148  222.2155  236.9053  221.6200  176.6781  122.6574   68.2785   34.5364   22.4152 (83)
Total gains 287.0627  313.9595  350.4770  401.9727  445.8919  447.7636  423.9532  383.3727  335.9370  294.8707  276.4068  275.3806 (84)
```

```
-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                              21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          58.9186   59.0763   59.2317   59.9726   60.1133   60.7770   60.7770   60.9016   60.5197   60.1133   59.8294   59.5354
alpha         4.9279    4.9384    4.9488    4.9982    5.0076    5.0518    5.0518    5.0601    5.0346    5.0076    4.9886    4.9690
util living area
              0.9957    0.9926    0.9820    0.9394    0.8210    0.6286    0.4718    0.5389    0.8121    0.9656    0.9919    0.9965 (86)

MIT          19.8237   19.9537   20.2087   20.5648   20.8443   20.9691   20.9940   20.9888   20.8921   20.5356   20.1254   19.8027 (87)
Th 2         20.4107   20.4122   20.4138   20.4210   20.4224   20.4287   20.4287   20.4299   20.4263   20.4224   20.4196   20.4168 (88)
util rest of house
              0.9950    0.9914    0.9787    0.9285    0.7923    0.5805    0.4129    0.4767    0.7718    0.9575    0.9903    0.9959 (89)
MIT 2        19.2988   19.4296   19.6841   20.0385   20.2995   20.4089   20.4258   20.4242   20.3487   20.0151   19.6071   19.2828 (90)
Living area fraction                                                                fLA = Living area / (4) =     0.7983 (91)
MIT          19.7178   19.8480   20.1029   20.4586   20.7344   20.8561   20.8794   20.8749   20.7825   20.4306   20.0209   19.6978 (92)
Temperature adjustment                                                                                            0.6000
adjusted MIT 20.3178   20.4480   20.7029   21.0586   21.3344   21.4561   21.4794   21.4749   21.3825   21.0306   20.6209   20.2978 (93)
```

```
-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9949    0.9914    0.9804    0.9404    0.8360    0.6646    0.5197    0.5880    0.8353    0.9660    0.9909    0.9958 (94)
Useful gains 285.5919  311.2710  343.6066  378.0108  372.7640  297.5855  220.3160  225.4407  280.6132  284.8445  273.8846  274.2243 (95)
Ext temp.     4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            760.8378  736.5511  671.0639  567.3784  448.5350  315.7047  224.6819  233.2071  336.7647  485.6041  632.4585  756.7189 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
            353.5829  285.7882  243.6282  136.3447   56.3736    0.0000    0.0000    0.0000    0.0000  149.3651  258.1732  358.9760 (98)
Space heating                                                                                                  1842.2319 (98)
Space heating per m2                                                                          (98) / (4) =      45.7130 (99)
```

```
-----------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------
Not applicable
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014


```
-----------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                0.0000 (201)
Fraction of space heat from main system(s)                                                           1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                    88.5000 (206)
Efficiency of secondary/supplementary heating system, %                                              0.0000 (208)
Space heating requirement                                                                         2081.6180 (211)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
            353.5829  285.7882  243.6282  136.3447   56.3736    0.0000    0.0000    0.0000    0.0000  149.3651  258.1732  358.9760 (98)
Space heating efficiency (main heating system 1)
             88.5000   88.5000   88.5000   88.5000   88.5000    0.0000    0.0000    0.0000    0.0000   88.5000   88.5000   88.5000 (210)
Space heating fuel (main heating system)
            399.5287  322.9246  275.2861  154.0618   63.6990    0.0000    0.0000    0.0000    0.0000  168.7741  291.7211  405.6226 (211)
Water heating requirement
              0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
            138.2020  121.6627  127.4217  113.7384  111.1074   98.7720   94.3782  104.2263  104.2504  117.9640  125.3468  134.7127 (64)
Efficiency of water heater                                                                                        74.8000 (216)
(217)m       82.1958   81.9976   81.4966   80.2773   78.0894   74.8000   74.8000   74.8000   74.8000   80.4235   81.6812   82.2880 (217)
Fuel for water heating, kWh/month
            168.1376  148.3735  156.3522  141.6819  142.2822  132.0482  126.1740  139.3400  139.3722  146.6786  153.4587  163.7087 (219)
Water heating fuel used                                                                                         1757.6078 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                2081.6180 (211)
Space heating fuel - secondary                                                                                     0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                           39.0000 (230c)
   main heating flue fan                                                                                          45.0000 (230e)
Total electricity for the above, kWh/year                                                                          84.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                               194.1534 (232)
Total delivered energy for all uses                                                                              4117.3792 (238)
```

```
-----------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------
                                                                  Energy   Emission factor        Emissions
                                                                kWh/year       kg CO2/kWh      kg CO2/year
Space heating - main system 1                                  2081.6180           0.2160         449.6295 (261)
Space heating - secondary                                         0.0000           0.0000           0.0000 (263)
Water heating (other fuel)                                     1757.6078           0.2160         379.6433 (264)
Space and water heating                                                                           829.2728 (265)
Pumps and fans                                                    84.0000           0.5190          43.5960 (267)
Energy for lighting                                              194.1534           0.5190         100.7656 (268)
Total CO2, kg/m2/year                                                                             973.6344 (272)
Emissions per m2 for space and water heating                                                       20.5775 (272a)
Fuel factor (mains gas)                                                                             1.0000
Emissions per m2 for lighting                                                                       2.5004 (272b)
Emissions per m2 for pumps and fans                                                                 1.0818 (272c)
Target Carbon Dioxide Emission Rate (TER) = (20.5775 * 1.00) + 2.5004 + 1.0818, rounded to 2 d.p.  24.1600 (273)
```

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	004 Block C1-1B2P-03281	**Issued on Date**	22/07/2020
Assessment Reference	1B2P no cooling	**Prop Type Ref**	Middle floor
Property	004 Block C1-1B2P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	**DER**	13.94	**TER**	15.87
Environmental	91 B	**% DER<TER**	12.16		
CO_2 Emissions (t/year)	0.60	**DFEE**	30.57	**TFEE**	31.39
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.61		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.87 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.94 kgCO□/m²OK
-----------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)31.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.6 kWh/m²/yrOK
-----------------------------------------------------------------------------------
2 Fabric U-values
Element          Average                 Highest
External wall    0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall       0.00 (max. 0.20)         -                        OK
Floor            (no floor)
Roof             (no roof)
Openings         1.26 (max. 2.00)        1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:          3.00 (design value)
Maximum                                  10.0                                     OK
-----------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                     Community heating scheme                 -

Secondary heating system:                None
-----------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                        Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                           OK
Primary pipework insulated:              No primary pipework
-----------------------------------------------------------------------------------
6 Controls
Space heating controls:                  Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                      No cylinderstat


-----------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                  75%                                      OK
-----------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                      0.42
Maximum                                  1.5                                      OK
MVHR efficiency:                         91%
Minimum:                                 70%                                      OK
-----------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):             Slight                                   OK
Based on:
Overshading:                             Average
Windows facing South East:               6.98 m², No overhang
Air change rate:                         2.00 ach
Blinds/curtains:                         None
-----------------------------------------------------------------------------------
10 Key features
Party wall U-value                       0.00 W/m²K
Door U-value                             0.82 W/m²K
Air permeability                         3.0 m³/m²h



-----------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------



-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                                          Area          Storey height               Volume
                                                                                          (m2)                (m)                    (m3)
Ground floor                                                                           50.4000 (1b)    x      2.5000 (2b)    =    126.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                 50.4000                                                              (4)
Dwelling volume                                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    126.0000 (5)



-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                                  main          secondary            other              total        m3 per hour
                                                               heating           heating
Number of chimneys                                                   0       +         0        +         0      =          0 * 40 =      0.0000 (6a)
Number of open flues                                                 0       +         0        +         0      =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                 0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                     0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                0 * 40 =      0.0000 (7c)

                                                                                                                       Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                       0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                           Yes
Measured/design AP50                                                                                                                 3.0000
Infiltration rate                                                                                                                    0.1500 (18)
Number of sides sheltered                                                                                                                 3 (19)

Shelter factor                                                                                   (20) =  1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                                      (21) = (18) x (20)   =      0.1163 (21)


                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                            0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                         77.3500 (23c)

Effective ac     0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)



-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                             Gross        Openings        NetArea        U-value         A x U        K-value         A x K
                                                       m2              m2             m2          W/m2K           W/K         kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                                  6.9800         1.3258        9.2538                                  (27)
Door                                                                              2.1200         0.8200        1.7384                                  (26)
External Wall                                     18.0800          6.9800        11.1000         0.1800        1.9980                                  (29a)
Wall to Stairwell                                 20.0500          2.1200        17.9300         0.1671        2.9955                                  (29a)
Total net area of external elements Aum(A, m2)                                   38.1300                                                               (31)
Fabric heat loss, W/K = Sum (A x U)                                                   (26)...(30) + (32) =     15.9857                                  (33)
Party Wall 1                                                                     34.3500         0.0000        0.0000                                  (32)
Party Floor 1                                                                    50.4000                                                               (32d)
Party Ceilings 1                                                                 50.4000                                                               (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                   250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                            5.6066 (36)
Total fabric heat loss                                                                                               (33) + (36) =    21.5923 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           10.8719    10.7510    10.6302    10.0260     9.9051     9.3009     9.3009     9.1801     9.5426     9.9051    10.1468    10.3885 (38)
Heat transfer coeff
                32.4642    32.3434    32.2225    31.6183    31.4975    30.8933    30.8933    30.7724    31.1349    31.4975    31.7392    31.9808 (39)
Average = Sum(39)m / 12 =                                                                                                            31.5881 (39)

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.6441     0.6417     0.6393     0.6273     0.6249     0.6130     0.6130     0.6106     0.6178     0.6249     0.6297     0.6345 (40)
HLP (average)                                                                                                                         0.6267 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                     1.7019 (42)
Average daily hot water use (litres/day)                                                                                             74.6197 (43)

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                82.0817    79.0969    76.1121    73.1273    70.1425    67.1577    67.1577    70.1425    73.1273    76.1121    79.0969    82.0817 (44)
Energy conte   121.7248   106.4613   109.8585    95.7773    91.9006    79.3032    73.4861    84.3264    85.3335    99.4480   108.5552   117.8839 (45)
Energy content (annual)                                                                                         Total = Sum(45)m =  1174.0587 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
                18.2587    15.9692    16.4788    14.3666    13.7851    11.8955    11.0229    12.6490    12.8000    14.9172    16.2833    17.6826 (46)
Water storage loss:
Store volume                                                                                                                          3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                          0.0212 (51)
  Volume factor from Table 2a                                                                                                         3.4200 (52)
  Temperature factor from Table 2b                                                                                                    1.0000 (53)
Enter (49) or (54) in (55)                                                                                                            0.2173 (55)
Total storage loss
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               151.7225   133.5560   139.8562   124.8073   121.8983   108.3332   103.4838   114.3241   114.3635   129.4456   137.5852   147.8816 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                       Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               151.7225   133.5560   139.8562   124.8073   121.8983   108.3332   103.4838   114.3241   114.3635   129.4456   137.5852   147.8816 (64)
                                                                                         Total per year (kWh/year) = Sum(64)m =   1527.2573 (64)
Heat gains from water heating, kWh/month
                64.4716    57.0741    60.5261    55.0700    54.5551    49.5923    48.4323    52.0367    51.5974    57.0646    59.3186    63.1946 (65)



-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                14.2147    12.6253    10.2676     7.7732     5.8106     4.9055     5.3006     6.8899     9.2477    11.7420    13.7047    14.6097 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               148.2728   149.8114   145.9342   137.6800   127.2605   117.4677   110.9256   109.3869   113.2642   121.5184   131.9378   141.7306 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753 (71)
Water heating gains (Table 5)
                86.6554    84.9317    81.3523    76.4861    73.3267    68.8783    65.0972    69.9418    71.6631    76.6997    82.3870    84.9389 (72)
Total internal gains
               297.6711   295.8967   286.0823   270.4675   254.9261   239.7798   229.8516   234.7469   242.7032   258.4884   276.5577   289.8075 (73)



-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------
[Jan]                                        Area       Solar flux               g               FF           Access             Gains
                                               m2        Table 6a    Specific data    Specific data           factor                 W
                                                             W/m2      or Table 6b      or Table 6c         Table 6d
-------------------------------------------------------------------------------------------------
Southeast                                  6.9800         36.7938           0.4000           0.7000           0.7700           49.8335 (77)
-------------------------------------------------------------------------------------------------

Solar gains     49.8335    84.8850   116.1433   143.9072   161.1880   160.0224   154.2787   141.3864   125.7586    93.8160    59.6891    42.6471 (83)
Total gains    347.5047   380.7817   402.2256   414.3747   416.1141   399.8022   384.1302   376.1333   368.4618   352.3043   336.2468   332.4546 (84)



-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            107.8111   108.2139   108.6197   110.6954   111.1200   113.2933   113.2933   113.7382   112.4139   111.1200   110.2739   109.4405
alpha            8.1874     8.2143     8.2413     8.3797     8.4080     8.5529     8.5529     8.5825     8.4943     8.4080     8.3516     8.2960
util living area
                 0.9904     0.9782     0.9460     0.8544     0.6926     0.4939     0.3538     0.3763     0.5805     0.8584     0.9733     0.9928 (86)

MIT             20.5937    20.6956    20.8218    20.9412    20.9903    20.9995    21.0000    21.0000    20.9981    20.9482    20.7655    20.5739 (87)
Th 2            20.3904    20.3926    20.3947    20.4054    20.4076    20.4183    20.4183    20.4205    20.4140    20.4076    20.4033    20.3990 (88)
util rest of house
                 0.9878     0.9726     0.9332     0.8269     0.6522     0.4493     0.3071     0.3289     0.5323     0.8264     0.9655     0.9908 (89)
MIT 2           19.8520    19.9994    20.1769    20.3416    20.3989    20.4180    20.4183    20.4205    20.4127    20.3540    20.1091    19.8308 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.5843 (91)
MIT             20.2854    20.4062    20.5537    20.6920    20.7445    20.7578    20.7582    20.7591    20.7548    20.7012    20.4926    20.2650 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT    20.2854    20.4062    20.5537    20.6920    20.7445    20.7578    20.7582    20.7591    20.7548    20.7012    20.4926    20.2650 (93)



-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9873     0.9728     0.9368     0.8406     0.6754     0.4754     0.3344     0.3566     0.5605     0.8429     0.9668     0.9903 (94)
Useful gains   343.0886   370.4195   376.7955   348.3103   281.0556   190.0605   128.4532   134.1272   206.5107   296.9437   325.0798   329.2276 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               518.9528   501.5233   452.8472   372.8433   284.8786   190.2344   128.4605   134.1396   207.1958   318.1621   425.0713   513.7715 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               130.8430    88.1018    56.5825    17.6637     2.8444     0.0000     0.0000     0.0000     0.0000    15.7865    71.9939   137.3007 (98)
Space heating                                                                                                                       521.1163 (98)
Space heating per m2                                                                                             (98) / (4) =        10.3396 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


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9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                  0.0000 (301)
Fraction of space heat from community system                                           1.0000 (302)
Fraction of heat from community Boilers                                                1.0000 (303a)
Fraction of total space heat from community Boilers                                    1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating       1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating       1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                      1.0500 (306)
Space heating:
Annual space heating requirement                                                     521.1163 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                  547.1721 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                  0.0000 (309)

Water heating
Annual water heating requirement                                                    1527.2573 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                 1603.6202 (310a)
Electricity used for heat distribution                                                21.5079 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                   80.7030 (330a)
Total electricity for the above, kWh/year                                             80.7030 (331)
Electricity for lighting (calculated in Appendix L)                                  251.0355 (332)
Total delivered energy for all uses                                                 2482.5309 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                      Energy    Emission factor      Emissions
                                                    kWh/year        kg CO2/kWh    kg CO2/year
Efficiency of heat source Boilers                                                    89.5000 (367a)
Space heating from Boilers                         2403.1199            0.2160      519.0739 (367)
Electrical energy for heat distribution              21.5079            0.5190       11.1626 (372)
Total CO2 associated with community systems                                         530.2365 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                             530.2365 (376)
Pumps and fans                                       80.7030            0.5190       41.8849 (378)
Energy for lighting                                 251.0355            0.5190      130.2874 (379)
Total CO2, kg/year                                                                  702.4088 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                          13.9400 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                  13.9400 ZC1
Total Floor Area                                                             TFA     50.4000
Assumed number of occupants                                                    N      1.7019
CO2 emission factor in Table 12 for electricity displaced from grid           EF      0.5190
CO2 emissions from appliances, equation (L14)                                        17.4332 ZC2
CO2 emissions from cooking, equation (L16)                                            3.1715 ZC3
Total CO2 emissions                                                                  34.5447 ZC4
Residual CO2 emissions offset from biofuel CHP                                        0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                              0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation       0.0000 ZC7
Net CO2 emissions                                                                    34.5447 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                          Area       Storey height          Volume
                                                          (m2)             (m)               (m3)
Ground floor                                          50.4000 (1b)   x   2.5000 (2b)  =  126.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        50.4000                             (4)
Dwelling volume                                         (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =  126.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                          main         secondary          other          total      m3 per hour
                                       heating           heating
Number of chimneys                           0     +         0     +         0    =     0 * 40 =     0.0000 (6a)
Number of open flues                         0     +         0     +         0    =     0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                             2 * 10 =    20.0000 (7a)
Number of passive vents                                                                 0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                            0 * 40 =     0.0000 (7c)

                                                                                        Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =       20.0000 / (5) =    0.1587 (8)
Pressure test                                                                                           Yes
Measured/design AP50                                                                                 5.0000
Infiltration rate                                                                                    0.4087 (18)
Number of sides sheltered                                                                                 3 (19)

Shelter factor                                                      (20) = 1  -  [0.075 x (19)]  =   0.7750 (20)
Infiltration rate adjusted to include shelter factor                      (21) = (18) x (20)  =   0.3168 (21)


                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.4039    0.3960    0.3880    0.3484    0.3405    0.3009    0.3009    0.2930    0.3168    0.3405    0.3564    0.3722 (22b)
Effective ac  0.5816    0.5784    0.5753    0.5607    0.5580    0.5453    0.5453    0.5429    0.5502    0.5580    0.5635    0.5693 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                 Gross    Openings     NetArea     U-value      A x U     K-value       A x K
                                           m2          m2          m2      W/m2K         W/K      kJ/m2K        kJ/K
TER Opaque door                                                2.1200      1.0000     2.1200                        (26)
TER Opening Type (Uw = 1.40)                                   6.9800      1.3258     9.2538                        (27)
External Wall                         18.0800      6.9800     11.1000      0.1800     1.9980                        (29a)
Wall to Stairwell                     20.0500      2.1200     17.9300      0.1800     3.2274                        (29a)
Total net area of external elements Aum(A, m2)                38.1300                                               (31)
Fabric heat loss, W/K = Sum (A x U)                       (26)...(30) + (32) =       16.5992                        (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                        250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                 3.6645 (36)
Total fabric heat loss                                                                     (33) + (36) =  20.2637 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m        24.1812   24.0495   23.9204   23.3142   23.2007   22.6727   22.6727   22.5749   22.8761   23.2007   23.4302   23.6701 (38)
Heat transfer coeff
             44.4449   44.3132   44.1841   43.5778   43.4644   42.9364   42.9364   42.8386   43.1398   43.4644   43.6939   43.9338 (39)
Average = Sum(39)m / 12 =                                                                                         43.5773 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP           0.8818    0.8792    0.8767    0.8646    0.8624    0.8519    0.8519    0.8500    0.8559    0.8624    0.8669    0.8717 (40)
HLP (average)                                                                                                      0.8646 (40)
Days in month
                  31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                  1.7019 (42)
Average daily hot water use (litres/day)                                                                         74.6197 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             82.0817   79.0969   76.1121   73.1273   70.1425   67.1577   67.1577   70.1425   73.1273   76.1121   79.0969   82.0817 (44)
Energy conte 121.7248 106.4613  109.8585   95.7773   91.9006   79.3032   73.4861   84.3264   85.3335   99.4480  108.5552  117.8839 (45)
Energy content (annual)                                                                      Total = Sum(45)m =  1174.0587 (45)
Distribution loss  (46)m = 0.15 x (45)m
             18.2587   15.9692   16.4788   14.3666   13.7851   11.8955   11.0229   12.6490   12.8000   14.9172   16.2833   17.6826 (46)
Water storage loss:
Store volume                                                                                                       3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                      0.2602 (48)
  Temperature factor from Table 2b                                                                                 0.5400 (49)
Enter (49) or (54) in (55)                                                                                         0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               149.3424   131.4063   137.4762   122.5041   119.5183   106.0300   101.1038   111.9440   112.0603   127.0656   135.2820   145.5016 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                   Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               149.3424   131.4063   137.4762   122.5041   119.5183   106.0300   101.1038   111.9440   112.0603   127.0656   135.2820   145.5016 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =  1499.2345 (64)
Heat gains from water heating, kWh/month
                62.5676    55.3544    58.6221    53.2274    52.6511    47.7497    46.5283    50.1327    49.7548    55.1606    57.4760    61.2905 (65)
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-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                14.2147    12.6253    10.2676     7.7732     5.8106     4.9055     5.3006     6.8899     9.2477    11.7420    13.7047    14.6097 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               148.2728   149.8114   145.9342   137.6800   127.2605   117.4677   110.9256   109.3869   113.2642   121.5184   131.9378   141.7306 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753 (71)
Water heating gains (Table 5)
                84.0963    82.3726    78.7931    73.9269    70.7676    66.3191    62.5380    67.3826    69.1039    74.1406    79.8278    82.3798 (72)
Total internal gains
               298.1120   296.3375   286.5231   270.9084   255.3670   240.2206   230.2924   235.1877   243.1440   258.9292   276.9986   290.2484 (73)
```

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-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------
[Jan]                                       Area        Solar flux              g              FF              Access                Gains
                                              m2          Table 6a    Specific data   Specific data            factor                    W
                                                              W/m2      or Table 6b     or Table 6c          Table 6d
-----------------------------------------------------------------------------------------------------
Southeast                                 6.9800           36.7938           0.6300          0.7000            0.7700              78.4878 (77)
-----------------------------------------------------------------------------------------------------

Solar gains     78.4878   133.6938   182.9257   226.6538   253.8711   252.0353   242.9889   222.6835   198.0698   147.7601    94.0103    67.1692 (83)
Total gains    376.5998   430.0313   469.4488   497.5622   509.2381   492.2559   473.2813   457.8713   441.2138   406.6894   371.0089   357.4176 (84)
```

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-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                    21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             78.7492    78.9833    79.2140    80.3160    80.5256    81.5160    81.5160    81.7020    81.1316    80.5256    80.1027    79.6653
alpha            6.2499     6.2656     6.2809     6.3544     6.3684     6.4344     6.4344     6.4468     6.4088     6.3684     6.3402     6.3110
util living area
                 0.9929     0.9829     0.9577     0.8878     0.7478     0.5524     0.3985     0.4293     0.6560     0.9054     0.9824     0.9947 (86)

MIT             20.2784    20.4301    20.6253    20.8318    20.9539    20.9943    20.9994    20.9990    20.9838    20.8352    20.5229    20.2490 (87)
Th 2            20.1830    20.1852    20.1874    20.1977    20.1996    20.2086    20.2086    20.2102    20.2051    20.1996    20.1957    20.1916 (88)
util rest of house
                 0.9907     0.9780     0.9458     0.8594     0.6970     0.4867     0.3272     0.3562     0.5879     0.8751     0.9765     0.9930 (89)
MIT 2           19.2280    19.4481    19.7257    20.0114    20.1578    20.2050    20.2083    20.2098    20.1936    20.0229    19.5916    19.1922 (90)
Living area fraction                                                                                  fLA = Living area / (4) =     0.5843 (91)
MIT             19.8418    20.0219    20.2513    20.4908    20.6230    20.6662    20.6706    20.6710    20.6554    20.4976    20.1358    19.8097 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT    19.8418    20.0219    20.2513    20.4908    20.6230    20.6662    20.6706    20.6710    20.6554    20.4976    20.1358    19.8097 (93)
```

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-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9896     0.9768     0.9469     0.8704     0.7246     0.5249     0.3689     0.3989     0.6271     0.8873     0.9760     0.9921 (94)
Useful gains   372.6862   420.0689   444.5171   433.0955   368.9784   258.4016   174.5941   182.6658   276.7012   360.8582   362.0868   354.5931 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               690.7526   670.0989   607.5912   505.1003   387.8338   260.4609   174.7756   182.9630   282.7967   430.1914   569.5834   685.7942 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               236.6414   168.0202   121.3271    51.8434    14.0284     0.0000     0.0000     0.0000     0.0000    51.5839   149.3976   246.4136 (98)
Space heating                                                                                                                    1039.2555 (98)
Space heating per m2                                                                                         (98) / (4) =    20.6201 (99)
```

```
-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014


```
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                       0.0000 (201)
Fraction of space heat from main system(s)                                                                                 1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                          93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                    0.0000 (208)
Space heating requirement                                                                                               1111.5033 (211)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               236.6414   168.0202   121.3271    51.8434    14.0284     0.0000     0.0000     0.0000     0.0000    51.5839   149.3976   246.4136 (98)
Space heating efficiency (main heating system 1)
                93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
               253.0924   179.7007   129.7616    55.4475    15.0037     0.0000     0.0000     0.0000     0.0000    55.1700   159.7835   263.5440 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               149.3424   131.4063   137.4762   122.5041   119.5183   106.0300   101.1038   111.9440   112.0603   127.0656   135.2820   145.5016 (64)
Efficiency of water heater                                                                                                79.8000 (216)
(217)m          86.0365    85.4705    84.4826    82.7078    80.8036    79.8000    79.8000    79.8000    79.8000    82.6206    85.0789    86.2085 (217)
Fuel for water heating, kWh/month
               173.5804   153.7445   162.7271   148.1168   147.9121   132.8697   126.6964   140.2808   140.4264   153.7942   159.0077   168.7787 (219)
Water heating fuel used                                                                                                 1807.9348 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                        1111.5033 (211)
Space heating fuel - secondary                                                                                             0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                   30.0000 (230c)
   main heating flue fan                                                                                                  45.0000 (230e)
Total electricity for the above, kWh/year                                                                                 75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                      251.0355 (232)
Total delivered energy for all uses                                                                                     3245.4735 (238)
```

```
-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                                 Energy    Emission factor         Emissions
                                                                               kWh/year         kg CO2/kWh       kg CO2/year
Space heating - main system 1                                                 1111.5033             0.2160          240.0847 (261)
Space heating - secondary                                                        0.0000             0.0000            0.0000 (263)
Water heating (other fuel)                                                    1807.9348             0.2160          390.5139 (264)
Space and water heating                                                                                           630.5986 (265)
Pumps and fans                                                                  75.0000             0.5190           38.9250 (267)
Energy for lighting                                                            251.0355             0.5190          130.2874 (268)
Total CO2, kg/m2/year                                                                                             799.8110 (272)
Emissions per m2 for space and water heating                                                                       12.5119 (272a)
Fuel factor (mains gas)                                                                                             1.0000
Emissions per m2 for lighting                                                                                       2.5851 (272b)
Emissions per m2 for pumps and fans                                                                                 0.7723 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5119 * 1.00) + 2.5851 + 0.7723, rounded to 2 d.p.                  15.8700 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	005 Block D2-2B3P-03281	**Issued on Date**	22/07/2020
Assessment Reference	2B3P no cooling	**Prop Type Ref**	Middle floor
Property	005 Block D2-2B3P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	**DER**	14.07	**TER**	15.32
Environmental	90 B	**% DER<TER**	8.16		
CO_2 Emissions (t/year)	0.71	**DFEE**	34.72	**TFEE**	34.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.65		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.32 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.07 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)34.7 kWh/m²/yrOK
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)         OK
Party wall      0.00 (max. 0.20)        -                       OK
Floor           (no floor)
Roof            (no roof)
Openings        1.31 (max. 2.00)       1.40 (max. 3.30)         OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                         OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Community heating scheme                     -

Secondary heating system:              None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                         OK
Primary pipework insulated:            No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                    No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                          OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.42
Maximum                                1.5                                          OK
MVHR efficiency:                       91%
Minimum:                               70%                                          OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):           Slight                                       OK
Based on:
Overshading:                           Average
Windows facing South East:             10.98 m², No overhang
Air change rate:                       2.00 ach
Blinds/curtains:                       None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                     0.00 W/m²K
Door U-value                           0.82 W/m²K
Air permeability                       3.0 m³/m²h



-----------------------------------------------------------------------------------------------------
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------
                                                                          Area         Storey height              Volume
                                                                          (m2)              (m)                   (m3)
Ground floor                                                           62.2000 (1b)    x      2.5000 (2b)    =    155.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)         62.2000                                                     (4)
Dwelling volume                                                             (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    155.5000 (5)


-----------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------
                                                            main          secondary            other              total        m3 per hour
                                                          heating           heating
Number of chimneys                                              0     +          0     +          0      =           0 * 40 =       0.0000 (6a)
Number of open flues                                            0     +          0     +          0      =           0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                                          0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                              0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                         0 * 40 =       0.0000 (7c)

                                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                  0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                          Yes
Measured/design AP50                                                                                                                3.0000
Infiltration rate                                                                                                                   0.1500 (18)
Number of sides sheltered                                                                                                                3 (19)

Shelter factor                                                                                  (20) = 1  -  [0.075 x (19)]  =       0.7750 (20)
Infiltration rate adjusted to include shelter factor                                                   (21) = (18) x (20)  =       0.1163 (21)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                          0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                      77.3500 (23c)

Effective ac     0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)


-----------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------
Element                                          Gross        Openings        NetArea       U-value          A x U         K-value          A x K
                                                    m2              m2             m2         W/m2K            W/K          kJ/m2K           kJ/K
Window Double-Glazed (Uw = 1.40)                                               10.9800        1.3258        14.5568                                  (27)
Door                                                                            2.1200        0.8200         1.7384                                  (26)
External Wall                                  24.6800         10.9800        13.7000        0.1800         2.4660                                  (29a)
Wall to CA                                     36.7000          2.1200        34.5800        0.1671         5.7772                                  (29a)
Total net area of external elements Aum(A, m2)                                 61.3800                                                               (31)
Fabric heat loss, W/K = Sum (A x U)                                              (26)...(30) + (32) =       24.5385                                  (33)
Party Wall 1                                                                   19.9500        0.0000         0.0000                                  (32)
Party Floor 1                                                                  62.2000                                                               (32d)
Party Ceilings 1                                                               62.2000                                                               (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                          7.8756 (36)
Total fabric heat loss                                                                                          (33) + (36) =      32.4141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           13.4173    13.2681    13.1190    12.3733    12.2242    11.4785    11.4785    11.3294    11.7768    12.2242    12.5225    12.8207 (38)
Heat transfer coeff
                45.8313    45.6822    45.5331    44.7874    44.6383    43.8926    43.8926    43.7434    44.1909    44.6383    44.9365    45.2348 (39)
Average = Sum(39)m / 12 =                                                                                                          44.7501 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.7368     0.7344     0.7320     0.7201     0.7177     0.7057     0.7057     0.7033     0.7105     0.7177     0.7225     0.7272 (40)
HLP (average)                                                                                                                       0.7195 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)


-----------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                   2.0431 (42)
Average daily hot water use (litres/day)                                                                                           82.7237 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                90.9961    87.6872    84.3782    81.0693    77.7603    74.4514    74.4514    77.7603    81.0693    84.3782    87.6872    90.9961 (44)
Energy conte   134.9446   118.0234   121.7896   106.1791   101.8814    87.9159    81.4670    93.4846    94.6011   110.2484   120.3448   130.6866 (45)
Energy content (annual)                                                                                        Total = Sum(45)m =   1301.5665 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
                20.2417    17.7035    18.2684    15.9269    15.2822    13.1874    12.2200    14.0227    14.1902    16.5373    18.0517    19.6030 (46)
Water storage loss:
Store volume                                                                                                                        3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                       0.0212 (51)
  Volume factor from Table 2a                                                                                                       3.4200 (52)
  Temperature factor from Table 2b                                                                                                  1.0000 (53)
Enter (49) or (54) in (55)                                                                                                          0.2173 (55)
Total storage loss
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               164.9423   145.1181   151.7873   135.2091   131.8791   116.9459   111.4647   123.4823   123.6311   140.2461   149.3748   160.6843 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                   Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
               164.9423   145.1181   151.7873   135.2091   131.8791   116.9459   111.4647   123.4823   123.6311   140.2461   149.3748   160.6843 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1654.7651 (64)
Heat gains from water heating, kWh/month
                68.8672    60.9185    64.4932    58.5286    57.8737    52.4561    51.0859    55.0818    54.6789    60.6558    63.2387    67.4515 (65)


-----------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                16.3014    14.4788    11.7749     8.9144     6.6636     5.6257     6.0788     7.9014    10.6053    13.4658    15.7166    16.7545 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               178.4593   180.3112   175.6446   165.7099   153.1692   141.3827   133.5086   131.6568   136.3234   146.2580   158.7987   170.5852 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242 (71)
Water heating gains (Table 5)
                92.5635    90.6526    86.6844    81.2897    77.7873    72.8556    68.6639    74.0346    75.9429    81.5266    87.8315    90.6606 (72)
Total internal gains
               340.9708   339.0891   327.7505   309.5606   291.2667   273.5106   261.8979   267.2394   276.5181   294.8970   315.9934   331.6469 (73)


-----------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------
[Jan]                                    Area        Solar flux              g               FF            Access            Gains
                                           m2          Table 6a   Specific data   Specific data            factor                W
                                                          W/m2     or Table 6b     or Table 6c          Table 6d
-----------------------------------------------------------------------------------------------
Southeast                             10.9800           36.7938          0.4000          0.7000            0.7700          78.3914 (77)
-----------------------------------------------------------------------------------------------

Solar gains     78.3914   133.5296   182.7011   226.3755   253.5594   251.7258   242.6905   222.4101   197.8266   147.5787    93.8949    67.0867 (83)
Total gains    419.3622   472.6187   510.4515   535.9360   544.8260   525.2364   504.5884   489.6495   474.3447   442.4756   409.8882   398.7336 (84)


-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                       21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             94.2465    94.5542    94.8639    96.4433    96.7655    98.4094    98.4094    98.7449    97.7452    96.7655    96.1232    95.4894
alpha            7.2831     7.3036     7.3243     7.4296     7.4510     7.5606     7.5606     7.5830     7.5163     7.4510     7.4082     7.3660
util living area
                 0.9943     0.9855     0.9610     0.8862     0.7354     0.5326     0.3826     0.4107     0.6343     0.9017     0.9844     0.9959 (86)

MIT             20.4311    20.5594    20.7226    20.8903    20.9762    20.9981    20.9999    20.9998    20.9934    20.8931    20.6379    20.4064 (87)
Th 2            20.3084    20.3105    20.3126    20.3232    20.3253    20.3358    20.3358    20.3379    20.3316    20.3253    20.3210    20.3168 (88)
util rest of house
                 0.9926     0.9814     0.9504     0.8599     0.6902     0.4784     0.3249     0.3517     0.5764     0.8731     0.9793     0.9946 (89)
MIT 2           19.5493    19.7359    19.9685    20.2014    20.3037    20.3346    20.3358    20.3378    20.3269    20.2105    19.8589    19.5203 (90)
Living area fraction                                                                                fLA = Living area / (4) =       0.4879 (91)
MIT             19.9796    20.1377    20.3365    20.5375    20.6319    20.6584    20.6598    20.6608    20.6521    20.5436    20.2390    19.9527 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT    19.9796    20.1377    20.3365    20.5375    20.6319    20.6584    20.6598    20.6608    20.6521    20.5436    20.2390    19.9527 (93)


-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9917     0.9802     0.9508     0.8687     0.7112     0.5048     0.3531     0.3805     0.6045     0.8830     0.9785     0.9938 (94)
Useful gains   415.8660   463.2708   485.3603   465.5864   387.4602   265.1504   178.1515   186.3072   286.7410   390.7268   401.0867   396.2751 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               718.6169   696.0934   630.0160   521.2142   398.7032   265.9169   178.1956   186.3833   289.5432   443.8633   590.4205   712.5690 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               225.2467   156.4568   107.6239    40.0520     8.3648     0.0000     0.0000     0.0000     0.0000    39.5336   136.3203   235.3227 (98)
Space heating                                                                                                                     948.9207 (98)
Space heating per m2                                                                                          (98) / (4) =      15.2560 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
------------------------------------------------------------------------------------------------
8c. Space cooling requirement
------------------------------------------------------------------------------------------------
Not applicable


------------------------------------------------------------------------------------------------
9b. Energy requirements
------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                  0.0000 (301)
Fraction of space heat from community system                                           1.0000 (302)
Fraction of heat from community Boilers                                                1.0000 (303a)
Fraction of total space heat from community Boilers                                    1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating      1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating      1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                      1.0500 (306)
Space heating:
Annual space heating requirement                                                     948.9207 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                  996.3667 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)
Space heating fuel for secondary/supplementary system                                  0.0000 (309)

Water heating
Annual water heating requirement                                                    1654.7651 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                 1737.5034 (310a)
Electricity used for heat distribution                                                27.3387 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                   99.5978 (330a)
Total electricity for the above, kWh/year                                             99.5978 (331)
Electricity for lighting (calculated in Appendix L)                                  287.8882 (332)
Total delivered energy for all uses                                                 3121.3561 (338)


------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
------------------------------------------------------------------------------------------------
                                                        Energy   Emission factor       Emissions
                                                      kWh/year       kg CO2/kWh      kg CO2/year
Efficiency of heat source Boilers                                                     89.5000 (367a)
Space heating from Boilers                           3054.6035           0.2160      659.7944 (367)
Electrical energy for heat distribution                27.3387           0.5190       14.1888 (372)
Total CO2 associated with community systems                                          673.9831 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                              673.9831 (376)
Pumps and fans                                         99.5978           0.5190       51.6912 (378)
Energy for lighting                                   287.8882           0.5190      149.4140 (379)
Total CO2, kg/year                                                                   875.0884 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                           14.0700 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                   14.0700 ZC1
Total Floor Area                                                              TFA     62.2000
Assumed number of occupants                                                     N      2.0431
CO2 emission factor in Table 12 for electricity displaced from grid            EF      0.5190
CO2 emissions from appliances, equation (L14)                                         17.0018 ZC2
CO2 emissions from cooking, equation (L16)                                             2.7015 ZC3
Total CO2 emissions                                                                   33.7733 ZC4
Residual CO2 emissions offset from biofuel CHP                                         0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                               0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation        0.0000 ZC7
Net CO2 emissions                                                                     33.7733 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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------------------------------------------------------------------------------------------------


------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
------------------------------------------------------------------------------------------------
                                                                 Area       Storey height          Volume
                                                                 (m2)                 (m)           (m3)
Ground floor                                              62.2000 (1b)   x     2.5000 (2b)   =   155.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            62.2000                                 (4)
Dwelling volume                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   155.5000 (5)


------------------------------------------------------------------------------------------------
2. Ventilation rate
------------------------------------------------------------------------------------------------
                                          main          secondary            other           total      m3 per hour
                                       heating            heating
Number of chimneys                           0     +            0     +          0     =       0 * 40 =     0.0000 (6a)
Number of open flues                         0     +            0     +          0     =       0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                    2 * 10 =    20.0000 (7a)
Number of passive vents                                                                        0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                   0 * 40 =     0.0000 (7c)

                                                                                         Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =           20.0000 / (5) =     0.1286 (8)
Pressure test                                                                                                 Yes
Measured/design AP50                                                                                       5.0000
Infiltration rate                                                                                          0.3786 (18)
Number of sides sheltered                                                                                       3 (19)

Shelter factor                                                          (20) = 1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                         (21) = (18) x (20)  =     0.2934 (21)


                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed    5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor   1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
              0.3741   0.3668   0.3594   0.3228   0.3154   0.2788   0.2788   0.2714   0.2934   0.3154   0.3301   0.3448 (22b)
Effective ac  0.5700   0.5673   0.5646   0.5521   0.5497   0.5389   0.5389   0.5368   0.5431   0.5497   0.5545   0.5594 (25)



------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
------------------------------------------------------------------------------------------------
Element                                      Gross    Openings     NetArea     U-value       A x U     K-value       A x K
                                                m2          m2          m2      W/m2K         W/K      kJ/m2K        kJ/K
TER Opaque door                                                    2.1200      1.0000      2.1200                        (26)
TER Opening Type (Uw = 1.40)                                      10.9800      1.3258     14.5568                        (27)
External Wall                              24.6800     10.9800    13.7000      0.1800      2.4660                        (29a)
Wall to CA                                 36.7000      2.1200    34.5800      0.1800      6.2244                        (29a)
Total net area of external elements Aum(A, m2)                    61.3800                                                (31)
Fabric heat loss, W/K = Sum (A x U)                         (26)...(30) + (32) =         25.3672                        (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                            250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                     5.2265 (36)
Total fabric heat loss                                                                       (33) + (36) =    30.5937 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m        29.2487  29.1092  28.9726  28.3305  28.2104  27.6512  27.6512  27.5477  27.8666  28.2104  28.4534  28.7075 (38)
Heat transfer coeff
             59.8424  59.7030  59.5663  58.9243  58.8041  58.2449  58.2449  58.1414  58.4603  58.8041  59.0471  59.3012 (39)
Average = Sum(39)m / 12 =                                                                                      58.9237 (39)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP           0.9621   0.9599   0.9577   0.9473   0.9454   0.9364   0.9364   0.9347   0.9399   0.9454   0.9493   0.9534 (40)
HLP (average)                                                                                                   0.9473 (40)
Days in month
                  31       28       31       30       31       30       31       31       30       31       30       31 (41)



------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                               2.0431 (42)
Average daily hot water use (litres/day)                                                                       82.7237 (43)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
             90.9961  87.6872  84.3782  81.0693  77.7603  74.4514  74.4514  77.7603  81.0693  84.3782  87.6872  90.9961 (44)
Energy conte 134.9446 118.0234 121.7896 106.1791 101.8814 87.9159 81.4670  93.4846  94.6011 110.2484 120.3448 130.6866 (45)
Energy content (annual)                                                                   Total = Sum(45)m =  1301.5665 (45)
Distribution loss  (46)m = 0.15 x (45)m
             20.2417  17.7035  18.2684  15.9269  15.2822  13.1874  12.2200  14.0227  14.1902  16.5373  18.0517  19.6030 (46)
Water storage loss:
Store volume                                                                                                    3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                   0.2602 (48)
  Temperature factor from Table 2b                                                                              0.5400 (49)
Enter (49) or (54) in (55)                                                                                      0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               162.5623   142.9684   149.4073   132.9059   129.4991   114.6427   109.0847   121.1022   121.3279   137.8661   147.0716   158.3043 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                         Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               162.5623   142.9684   149.4073   132.9059   129.4991   114.6427   109.0847   121.1022   121.3279   137.8661   147.0716   158.3043 (64)
                                                                                           Total per year (kWh/year) = Sum(64)m =  1626.7423 (64)
Heat gains from water heating, kWh/month
                66.9632    59.1988    62.5892    56.6860    55.9697    50.6135    49.1819    53.1778    52.8363    58.7517    61.3961    65.5474 (65)
```

```
---------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
---------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                16.3014    14.4788    11.7749     8.9144     6.6636     5.6257     6.0788     7.9014    10.6053    13.4658    15.7166    16.7545 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               178.4593   180.3112   175.6446   165.7099   153.1692   141.3827   133.5086   131.6568   136.3234   146.2580   158.7987   170.5852 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242 (71)
Water heating gains (Table 5)
                90.0043    88.0934    84.1252    78.7305    75.2281    70.2965    66.1047    71.4755    73.3837    78.9674    85.2723    88.1014 (72)
Total internal gains
               341.4116   339.5299   328.1913   310.0014   291.7075   273.9515   262.3387   267.6803   276.9589   295.3378   316.4342   332.0877 (73)
```

```
---------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------
[Jan]                                       Area       Solar flux              g                FF            Access            Gains
                                              m2         Table 6a    Specific data    Specific data            factor                W
                                                             W/m2      or Table 6b      or Table 6c          Table 6d
---------------------------------------------------------------------------------------------------
Southeast                                10.9800          36.7938           0.6300           0.7000            0.7700         123.4665 (77)
---------------------------------------------------------------------------------------------------

Solar gains    123.4665   210.3092   287.7542   356.5413   399.3560   396.4681   382.2376   350.2959   311.5769   232.4364   147.8844   105.6616 (83)
Total gains    464.8782   549.8391   615.9455   666.5428   691.0635   670.4196   644.5763   617.9761   588.5358   527.7742   464.3186   437.7493 (84)
```

```
---------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
---------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             72.1803    72.3489    72.5149    73.3050    73.4548    74.1600    74.1600    74.2921    73.8868    73.4548    73.1525    72.8391
alpha            5.8120     5.8233     5.8343     5.8870     5.8970     5.9440     5.9440     5.9528     5.9258     5.8970     5.8768     5.8559
util living area
                 0.9937     0.9831     0.9557     0.8820     0.7395     0.5484     0.3966     0.4311     0.6606     0.9099     0.9844     0.9954 (86)

MIT             20.1598    20.3420    20.5696    20.8038    20.9438    20.9919    20.9990    20.9984    20.9771    20.7940    20.4301    20.1223 (87)
Th 2            20.1150    20.1169    20.1188    20.1275    20.1291    20.1367    20.1367    20.1381    20.1337    20.1291    20.1258    20.1224 (88)
util rest of house
                 0.9918     0.9781     0.9431     0.8516     0.6855     0.4778     0.3193     0.3512     0.5874     0.8793     0.9789     0.9940 (89)
MIT 2           19.0036    19.2677    19.5909    19.9117    20.0786    20.1317    20.1363    20.1374    20.1176    19.9079    19.4037    18.9547 (90)
Living area fraction                                                                              fLA = Living area / (4) =     0.4879 (91)
MIT             19.5678    19.7919    20.0684    20.3470    20.5008    20.5514    20.5572    20.5575    20.5370    20.3403    19.9045    19.5244 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT    19.5678    19.7919    20.0684    20.3470    20.5008    20.5514    20.5572    20.5575    20.5370    20.3403    19.9045    19.5244 (93)
```

```
---------------------------------------------------------------------------------------------------
8. Space heating requirement
---------------------------------------------------------------------------------------------------

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9902     0.9759     0.9422     0.8598     0.7093     0.5120     0.3571     0.3903     0.6223     0.8876     0.9772     0.9928 (94)
Useful gains   460.3340   536.5619   580.3572   573.1107   490.1850   343.2866   230.1610   241.1717   366.2698   468.4276   453.7421   434.5791 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               913.6608   889.0911   808.2212   674.5066   517.5216   346.6400   230.4891   241.7235   376.3087   572.7706   756.0681   908.7555 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               337.2751   236.8996   169.5308    73.0051    20.3384     0.0000     0.0000     0.0000     0.0000    77.6312   217.6747   352.7873 (98)
Space heating                                                                                                                1485.1423 (98)
Space heating per m2                                                                                          (98) / (4) =     23.8769 (99)
```

```
---------------------------------------------------------------------------------------------------
8c. Space cooling requirement
---------------------------------------------------------------------------------------------------
Not applicable

---------------------------------------------------------------------------------------------------
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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9a. Energy requirements - Individual heating systems, including micro-CHP
---------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                     93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                               0.0000 (208)
Space heating requirement                                                                                          1588.3875 (211)

                    Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               337.2751   236.8996   169.5308    73.0051    20.3384     0.0000     0.0000     0.0000     0.0000    77.6312   217.6747   352.7873 (98)
Space heating efficiency (main heating system 1)
                93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
               360.7221   253.3686   181.3164    78.0803    21.7523     0.0000     0.0000     0.0000     0.0000    83.0280   232.8072   377.3126 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               162.5623   142.9684   149.4073   132.9059   129.4991   114.6427   109.0847   121.1022   121.3279   137.8661   147.0716   158.3043 (64)
Efficiency of water heater                                                                                                   79.8000 (216)
(217)m          86.7183    86.1523    85.1514    83.2915    81.1016    79.8000    79.8000    79.8000    79.8000    83.3501    85.8581    86.8913 (217)
Fuel for water heating, kWh/month
               187.4601   165.9484   175.4607   159.5672   159.6752   143.6625   136.6976   151.7572   152.0399   165.4061   171.2962   182.1866 (219)
Water heating fuel used                                                                                                    1951.1576 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                           1588.3875 (211)
Space heating fuel - secondary                                                                                                0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                      30.0000 (230c)
   main heating flue fan                                                                                                     45.0000 (230e)
Total electricity for the above, kWh/year                                                                                    75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                         287.8882 (232)
Total delivered energy for all uses                                                                                        3902.4333 (238)
```

```
---------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---------------------------------------------------------------------------------------------------
                                                                            Energy    Emission factor        Emissions
                                                                          kWh/year         kg CO2/kWh      kg CO2/year
Space heating - main system 1                                            1588.3875             0.2160         343.0917 (261)
Space heating - secondary                                                   0.0000             0.0000           0.0000 (263)
Water heating (other fuel)                                               1951.1576             0.2160         421.4500 (264)
Space and water heating                                                                                     764.5417 (265)
Pumps and fans                                                             75.0000             0.5190          38.9250 (267)
Energy for lighting                                                       287.8882             0.5190         149.4140 (268)
Total CO2, kg/m2/year                                                                                       952.8807 (272)
Emissions per m2 for space and water heating                                                                 12.2917 (272a)
Fuel factor (mains gas)                                                                                       1.0000
Emissions per m2 for lighting                                                                                 2.4022 (272b)
Emissions per m2 for pumps and fans                                                                           0.6258 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.2917 * 1.00) + 2.4022 + 0.6258, rounded to 2 d.p.            15.3200 (273)
```

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	006 Block E2-2B4P-03281	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	006 Block E2-2B4P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	**DER**	14.83	**TER**	15.44
Environmental	89 B	**% DER<TER**	3.96		
CO_2 Emissions (t/year)	0.88	**DFEE**	40.90	**TFEE**	40.67
General Requirements Compliance	Fail	**% DFEE<TFEE**	-0.58		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.44 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.83 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)40.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)40.9 kWh/m²/yrFail
Excess energy =0.2 kWh/m²/yr  (0.5%)
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.34 (max. 2.00)        1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                            -

Secondary heating system:               None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                           OK
Primary pipework insulated:             No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                 OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                                 OK
MVHR efficiency:                        91%
Minimum:                                70%                                                 OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Medium                                              OK
Based on:
Overshading:                            Average
Windows facing North East:              6.00 m², No overhang
Windows facing South East:              12.90 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                                  Area          Storey height                Volume
                                                                                  (m2)                  (m)                   (m3)
Ground floor                                                                   75.0000 (1b)     x      2.5000 (2b)     =     187.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                75.0000                                                         (4)
Dwelling volume                                                                      (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     187.5000 (5)

-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                               main            secondary            other             total       m3 per hour
                                                            heating              heating
Number of chimneys                                                0       +          0       +         0       =         0 * 40 =      0.0000 (6a)
Number of open flues                                              0       +          0       +         0       =         0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                              0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                  0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                             0 * 40 =      0.0000 (7c)

                                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                 0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                     Yes
Measured/design AP50                                                                                                           3.0000
Infiltration rate                                                                                                              0.1500 (18)
Number of sides sheltered                                                                                                           2 (19)

Shelter factor                                                                              (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                (21) = (18) x (20)  =      0.1275 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                     0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                 77.3500 (23c)

Effective ac     0.2758     0.2726     0.2694     0.2535     0.2503     0.2344     0.2344     0.2312     0.2408     0.2503     0.2567     0.2631 (25)

-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                          Gross       Openings         NetArea        U-value          A x U        K-value          A x K
                                                    m2             m2              m2          W/m2K            W/K         kJ/m2K           kJ/K
Window Double-Glazed (Uw = 1.40)                                              18.9000         1.3258        25.0568                              (27)
Door                                                                           2.1200         0.8200         1.7384                              (26)
External Wall                                  46.0800        18.9000         27.1800         0.1800         4.8924                              (29a)
Wall to CA                                     30.6800         2.1200         28.5600         0.1671         4.7715                              (29a)
Total net area of external elements Aum(A, m2)                                76.7600                                                        (31)
Fabric heat loss, W/K = Sum (A x U)                                              (26)...(30) + (32) =       36.4591                              (33)
Party Wall 1                                                                  20.0500         0.0000         0.0000                              (32)
Party Floor 1                                                                 75.0000                                                        (32d)
Party Ceilings 1                                                              75.0000                                                        (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                            250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                    10.1164 (36)
Total fabric heat loss                                                                                      (33) + (36) =     46.5755 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           17.0659    16.8687    16.6714    15.6853    15.4881    14.5020    14.5020    14.3047    14.8964    15.4881    15.8825    16.2770 (38)
Heat transfer coeff
                63.6414    63.4442    63.2470    62.2608    62.0636    61.0775    61.0775    60.8802    61.4719    62.0636    62.4580    62.8525 (39)
Average = Sum(39)m / 12 =                                                                                                     62.2115 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.8486     0.8459     0.8433     0.8301     0.8275     0.8144     0.8144     0.8117     0.8196     0.8275     0.8328     0.8380 (40)
HLP (average)                                                                                                                   0.8295 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)

-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                              2.3612 (42)
Average daily hot water use (litres/day)                                                                                      90.2775 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                99.3053    95.6942    92.0831    88.4720    84.8609    81.2498    81.2498    84.8609    88.4720    92.0831    95.6942    99.3053 (44)
Energy conte   147.2668   128.8005   132.9106   115.8747   111.1845    95.9438    88.9060   102.0210   103.2394   120.3156   131.3339   142.6201 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =  1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
                22.0900    19.3201    19.9366    17.3812    16.6777    14.3916    13.3359    15.3031    15.4859    18.0473    19.7001    21.3930 (46)
Water storage loss:
Store volume                                                                                                                   3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                   0.0212 (51)
  Volume factor from Table 2a                                                                                                  3.4200 (52)
  Temperature factor from Table 2b                                                                                             1.0000 (53)
Enter (49) or (54) in (55)                                                                                                     0.2173 (55)
Total storage loss
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               177.2645   155.8952   162.9083   144.9047   141.1822   124.9738   118.9037   132.0186   132.2694   150.3133   160.3639   172.6178 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                   Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               177.2645   155.8952   162.9083   144.9047   141.1822   124.9738   118.9037   132.0186   132.2694   150.3133   160.3639   172.6178 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =   1773.6154 (64)
Heat gains from water heating, kWh/month
                72.9644    64.5019    68.1909    61.7524    60.9670    55.1253    53.5594    57.9201    57.5511    64.0031    66.8925    71.4193 (65)

-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                18.6035    16.5235    13.4378    10.1733     7.6046     6.4202     6.9372     9.0173    12.1029    15.3675    17.9361    19.1206 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               208.6751   210.8404   205.3837   193.7670   179.1030   165.3209   156.1136   153.9482   159.4049   171.0216   185.6856   199.4678 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463 (71)
Water heating gains (Table 5)
                98.0704    95.9850    91.6545    85.7672    81.9449    76.5630    71.9884    77.8496    79.9321    86.0256    92.9063    95.9937 (72)
Total internal gains
               383.7664   381.7663   368.8934   348.1248   327.0699   306.7214   293.4566   299.2324   309.8573   330.8321   354.9454   372.9994 (73)

-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------
[Jan]                                          Area       Solar flux              g              FF          Access            Gains
                                                 m2        Table 6a   Specific data   Specific data          factor                W
                                                               W/m2     or Table 6b     or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------
Northeast                                    6.0000         11.2829          0.4000          0.7000          0.7700          13.1361 (75)
Southeast                                   12.9000         36.7938          0.4000          0.7000          0.7700          92.0992 (77)
-------------------------------------------------------------------------------------------------

Solar gains    105.2353   183.6179   262.8236   345.0772   404.2463   409.1223   391.1919   345.8567   291.1210   206.0617   126.8422    89.5453 (83)
Total gains    489.0016   565.3842   631.7170   693.2020   731.3162   715.8437   684.6485   645.0891   600.9784   536.8939   481.7876   462.5447 (84)

-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             81.8388    82.0932    82.3492    83.6535    83.9193    85.2742    85.2742    85.5505    84.7270    83.9193    83.3893    82.8660
alpha            6.4559     6.4729     6.4899     6.5769     6.5946     6.6849     6.6849     6.7034     6.6485     6.5946     6.5593     6.5244
util living area
                 0.9964     0.9902     0.9705     0.9012     0.7474     0.5417     0.3921     0.4332     0.6838     0.9337     0.9905     0.9974 (86)

MIT             20.2374    20.3881    20.5968    20.8290    20.9593    20.9958    20.9996    20.9992    20.9824    20.8082    20.4804    20.2106 (87)
Th 2            20.2115    20.2137    20.2160    20.2273    20.2296    20.2409    20.2409    20.2432    20.2364    20.2296    20.2250    20.2205 (88)
util rest of house
                 0.9953     0.9872     0.9617     0.8754     0.6979     0.4794     0.3247     0.3624     0.6168     0.9100     0.9871     0.9966 (89)
MIT 2           19.1908    19.4110    19.7110    20.0356    20.1926    20.2383    20.2407    20.2428    20.2236    20.0170    19.5551    19.1589 (90)
Living area fraction                                                                               fLA = Living area / (4) =      0.4516 (91)
MIT             19.6634    19.8523    20.1110    20.3939    20.5388    20.5804    20.5834    20.5844    20.5663    20.3743    19.9730    19.6338 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT    19.6634    19.8523    20.1110    20.3939    20.5388    20.5804    20.5834    20.5844    20.5663    20.3743    19.9730    19.6338 (93)

-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9943     0.9855     0.9604     0.8814     0.7184     0.5075     0.3551     0.3944     0.6464     0.9150     0.9858     0.9958 (94)
Useful gains   486.1965   557.1978   606.6900   610.9998   525.3744   363.2631   243.1424   254.4442   388.4945   491.2561   474.9321   460.6086 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               977.7515   948.6336   860.8566   715.6183   548.5680   365.2659   243.2979   254.7486   397.4938   606.6294   804.0211   970.0552 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               365.7169   263.0449   189.0999    75.3253    17.2561     0.0000     0.0000     0.0000     0.0000    85.8378   236.9441   379.0283 (98)
Space heating                                                                                                               1612.2532 (98)
Space heating per m2                                                                                          (98) / (4) =     21.4967 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                    0.0000 (301)
Fraction of space heat from community system                                             1.0000 (302)
Fraction of heat from community Boilers                                                  1.0000 (303a)
Fraction of total space heat from community Boilers                                      1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating         1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating         1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                        1.0500 (306)
Space heating:
Annual space heating requirement                                                      1612.2532 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                   1692.8658 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                    0.0000 (309)

Water heating
Annual water heating requirement                                                      1773.6154 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                   1862.2962 (310a)
Electricity used for heat distribution                                                  35.5516 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
   mechanical ventilation fans (SFP =       0.5500)                                    125.8125 (330a)
Total electricity for the above, kWh/year                                              125.8125 (331)
Electricity for lighting (calculated in Appendix L)                                    328.5442 (332)
Total delivered energy for all uses                                                   4009.5187 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                          Energy     Emission factor        Emissions
                                                       kWh/year          kg CO2/kWh      kg CO2/year
Efficiency of heat source Boilers                                                      89.5000 (367a)
Space heating from Boilers                            3972.2481              0.2160   858.0056 (367)
Electrical energy for heat distribution                 35.5516              0.5190    18.4513 (372)
Total CO2 associated with community systems                                           876.4569 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                               876.4569 (376)
Pumps and fans                                         125.8125              0.5190    65.2967 (378)
Energy for lighting                                    328.5442              0.5190   170.5144 (379)
Total CO2, kg/year                                                                   1112.2680 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                            14.8300 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                    14.8300 ZC1
Total Floor Area                                                                 TFA   75.0000
Assumed number of occupants                                                        N    2.3612
CO2 emission factor in Table 12 for electricity displaced from grid               EF    0.5190
CO2 emissions from appliances, equation (L14)                                          16.4875 ZC2
CO2 emissions from cooking, equation (L16)                                              2.3422 ZC3
Total CO2 emissions                                                                    33.6598 ZC4
Residual CO2 emissions offset from biofuel CHP                                          0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation         0.0000 ZC7
Net CO2 emissions                                                                      33.6598 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                    Area       Storey height           Volume
                                                                    (m2)            (m)                 (m3)
Ground floor                                                   75.0000 (1b)   x    2.5000 (2b)   =   187.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        75.0000                                         (4)
Dwelling volume                                                   (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   187.5000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                              main          secondary           other            total      m3 per hour
                                           heating            heating
Number of chimneys                               0      +           0      +        0      =        0 * 40 =     0.0000 (6a)
Number of open flues                             0      +           0      +        0      =        0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                         3 * 10 =    30.0000 (7a)
Number of passive vents                                                                             0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                        0 * 40 =     0.0000 (7c)

                                                                                              Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =              30.0000 / (5) =     0.1600 (8)
Pressure test                                                                                                   Yes
Measured/design AP50                                                                                         5.0000
Infiltration rate                                                                                            0.4100 (18)
Number of sides sheltered                                                                                         2 (19)

Shelter factor                                                              (20) = 1  -  [0.075 x (19)]  =   0.8500 (20)
Infiltration rate adjusted to include shelter factor                              (21) = (18) x (20)  =   0.3485 (21)


                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.4443    0.4356    0.4269    0.3834    0.3746    0.3311    0.3311    0.3224    0.3485    0.3746    0.3921    0.4095 (22b)
Effective ac  0.5987    0.5949    0.5911    0.5735    0.5702    0.5548    0.5548    0.5520    0.5607    0.5702    0.5769    0.5838 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                     Gross    Openings     NetArea     U-value      A x U     K-value        A x K
                                               m2          m2          m2      W/m2K         W/K      kJ/m2K         kJ/K
TER Opaque door                                                    2.1200      1.0000      2.1200                        (26)
TER Opening Type (Uw = 1.40)                                      16.6300      1.3258     22.0473                        (27)
External Wall                             46.0800     16.6300     29.4500      0.1800      5.3010                        (29a)
Wall to CA                                30.6800      2.1200     28.5600      0.1800      5.1408                        (29a)
Total net area of external elements Aum(A, m2)                    76.7600                                                (31)
Fabric heat loss, W/K = Sum (A x U)                                (26)...(30) + (32) =   34.6091                        (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                               250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                        6.3975 (36)
Total fabric heat loss                                                                            (33) + (36) =  41.0066 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m        37.0457   36.8085   36.5760   35.4840   35.2797   34.3286   34.3286   34.1525   34.6949   35.2797   35.6930   36.1251 (38)
Heat transfer coeff
             78.0523   77.8151   77.5826   76.4906   76.2863   75.3352   75.3352   75.1591   75.7016   76.2863   76.6996   77.1317 (39)
Average = Sum(39)m / 12 =                                                                                        76.4897 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP           1.0407    1.0375    1.0344    1.0199    1.0172    1.0045    1.0045    1.0021    1.0094    1.0172    1.0227    1.0284 (40)
HLP (average)                                                                                                     1.0199 (40)
Days in month
                  31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                 2.3612 (42)
Average daily hot water use (litres/day)                                                                         90.2775 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             99.3053   95.6942   92.0831   88.4720   84.8609   81.2498   81.2498   84.8609   88.4720   92.0831   95.6942   99.3053 (44)
Energy conte 147.2668  128.8005  132.9106  115.8747  111.1845   95.9438   88.9060  102.0210  103.2394  120.3156  131.3339  142.6201 (45)
Energy content (annual)                                                                    Total = Sum(45)m =  1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
             22.0900   19.3201   19.9366   17.3812   16.6777   14.3916   13.3359   15.3031   15.4859   18.0473   19.7001   21.3930 (46)
Water storage loss:
Store volume                                                                                                      3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                     0.2602 (48)
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	174.8845	153.7455	160.5283	142.6015	138.8022	122.6706	116.5237	129.6386	129.9662	147.9332	158.0606	170.2377	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	174.8845	153.7455	160.5283	142.6015	138.8022	122.6706	116.5237	129.6386	129.9662	147.9332	158.0606	170.2377	(64)
Total per year (kWh/year) = Sum(64)m =												1745.5926	(64)
Heat gains from water heating, kWh/month	71.0604	62.7822	66.2869	59.9098	59.0630	53.2827	51.6554	56.0161	55.7085	62.0991	65.0499	69.5153	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	118.0579	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.6058	16.5255	13.4395	10.1745	7.6056	6.4210	6.9381	9.0184	12.1044	15.3693	17.9383	19.1229	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	208.6751	210.8404	205.3837	193.7670	179.1030	165.3209	156.1136	153.9482	159.4049	171.0216	185.6856	199.4678	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	34.8058	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	-94.4463	(71)
Water heating gains (Table 5)	95.5112	93.4258	89.0953	83.2080	79.3857	74.0038	69.4293	75.2905	77.3730	83.4665	90.3471	93.4346	(72)
Total internal gains	384.2095	382.2092	369.3359	348.5669	327.5117	307.1630	293.8983	299.6744	310.2997	331.2748	355.3884	373.4426	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.2800	11.2829	0.6300	0.7000	0.7700	18.2066	(75)
Southeast	11.3500	36.7938	0.6300	0.7000	0.7700	127.6270	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	145.8336	254.4561	364.2211	478.2120	560.2126	566.9713	542.1223	479.2935	403.4370	285.5592	175.7764	124.0906	(83)
Total gains	530.0431	636.6653	733.5570	826.7789	887.7243	874.1343	836.0206	778.9679	713.7366	616.8341	531.1648	497.5332	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.7287	66.9321	67.1327	68.0911	68.2735	69.1354	69.1354	69.2974	68.8009	68.2735	67.9056	67.5252	
alpha	5.4486	5.4621	5.4755	5.5394	5.5516	5.6090	5.6090	5.6198	5.5867	5.5516	5.5270	5.5017	
util living area	0.9956	0.9877	0.9643	0.8906	0.7391	0.5426	0.3952	0.4413	0.6925	0.9319	0.9892	0.9968	(86)
MIT	20.0088	20.2023	20.4658	20.7573	20.9316	20.9899	20.9986	20.9974	20.9639	20.7195	20.3069	19.9757	(87)
Th 2	20.0496	20.0522	20.0547	20.0668	20.0691	20.0796	20.0796	20.0816	20.0755	20.0691	20.0645	20.0597	(88)
util rest of house	0.9942	0.9838	0.9534	0.8605	0.6826	0.4685	0.3132	0.3545	0.6147	0.9057	0.9852	0.9958	(89)
MIT 2	18.7353	19.0173	19.3948	19.7988	20.0080	20.0735	20.0791	20.0806	20.0499	19.7614	19.1800	18.6946	(90)
Living area fraction									fLA = Living area / (4) =			0.4516	(91)
MIT	19.3104	19.5524	19.8785	20.2316	20.4251	20.4873	20.4943	20.4946	20.4627	20.1941	19.6889	19.2731	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3104	19.5524	19.8785	20.2316	20.4251	20.4873	20.4943	20.4946	20.4627	20.1941	19.6889	19.2731	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9927	0.9813	0.9510	0.8664	0.7051	0.5018	0.3503	0.3938	0.6485	0.9097	0.9831	0.9946	(94)
Useful gains	526.1658	624.7291	697.5978	716.2803	625.9183	438.6080	292.8442	306.7376	462.8481	561.1576	522.1976	494.8539	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1171.5971	1140.1794	1037.9383	866.7634	665.6029	443.5237	293.3803	307.7474	481.6630	731.8978	965.5640	1162.6172	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	480.2009	346.3826	253.2134	108.3478	29.5253	0.0000	0.0000	0.0000	0.0000	127.0307	319.2238	496.8158	(98)
Space heating												2160.7404	(98)
Space heating per m2											(98) / (4) =	28.8099	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2310.9523	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	480.2009	346.3826	253.2134	108.3478	29.5253	0.0000	0.0000	0.0000	0.0000	127.0307	319.2238	496.8158	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	513.5838	370.4627	270.8164	115.8800	31.5779	0.0000	0.0000	0.0000	0.0000	135.8618	341.4159	531.3538	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	174.8845	153.7455	160.5283	142.6015	138.8022	122.6706	116.5237	129.6386	129.9662	147.9332	158.0606	170.2377	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3724	86.9173	86.0247	84.0927	81.4900	79.8000	79.8000	79.8000	79.8000	84.4107	86.6522	87.5056	(217)
Fuel for water heating, kWh/month	200.1599	176.8871	186.6073	169.5766	170.3304	153.7225	146.0197	162.4544	162.8649	175.2542	182.4080	194.5450	(219)
Water heating fuel used												2080.8298	(219)
Annual totals kWh/year													
Space heating fuel - main system												2310.9523	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	328.5844	(232)
Total delivered energy for all uses	4795.3665	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2310.9523	0.2160	499.1657	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2080.8298	0.2160	449.4592	(264)
Space and water heating			948.6249	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	328.5844	0.5190	170.5353	(268)
Total CO2, kg/m2/year			1158.0852	(272)
Emissions per m2 for space and water heating			12.6483	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2738	(272b)
Emissions per m2 for pumps and fans			0.5190	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.6483 * 1.00) + 2.2738 + 0.5190, rounded to 2 d.p.			15.4400	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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Property Reference	007 Block B1-2B4P-03281	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	007 Block B1-2B4P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	**DER**	14.74	**TER**	16.15
Environmental	89 B	**% DER<TER**	8.75		
CO_2 Emissions (t/year)	0.92	**DFEE**	42.13	**TFEE**	45.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.28		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 81 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.15 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.74 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.1 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.33 (max. 2.00)        1.40 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                  OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                              -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                   OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.42
Maximum                                 1.5                                                   OK
MVHR efficiency:                        91%
Minimum:                                70%                                                   OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                                OK
Based on:
Overshading:                            Average
Windows facing North East:              16.25 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	80.9000	(1b)	x	2.5000	(2b)	=	202.2500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.9000							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	202.2500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.3500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2615	0.2586	0.2557	0.2411	0.2382	0.2237	0.2237	0.2208	0.2295	0.2382	0.2440	0.2498	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window Double-Glazed (Uw = 1.40)			16.2500	1.3258	21.5436			(27)
Door			2.1200	0.8200	1.7384			(26)
External Wall	39.7000	16.2500	23.4500	0.1800	4.2210			(29a)
Wall to CA	41.3000	2.1200	39.1800	0.1671	6.5458			(29a)
Total net area of external elements Aum(A, m2)			81.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.0487			(33)
Party Wall 1			26.5000	0.0000	0.0000			(32)
Party Floor 1			80.9000					(32d)
Party Ceilings 1			80.9000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.1020	(36)
Total fabric heat loss	(33) + (36) =	44.1507	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	17.4511	17.2571	17.0631	16.0933	15.8993	14.9295	14.9295	14.7355	15.3174	15.8993	16.2873	16.6752	(38)
Heat transfer coeff	61.6018	61.4078	61.2139	60.2440	60.0500	59.0802	59.0802	58.8862	59.4681	60.0500	60.4380	60.8259	(39)
Average = Sum(39)m / 12 =												60.1955	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7615	0.7591	0.7567	0.7447	0.7423	0.7303	0.7303	0.7279	0.7351	0.7423	0.7471	0.7519	(40)
HLP (average)												0.7441	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4797 (42)
Average daily hot water use (litres/day) 93.0933 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.4026	98.6788	94.9551	91.2314	87.5077	83.7839	83.7839	87.5077	91.2314	94.9551	98.6788	102.4026	(44)
Energy conte	151.8601	132.8178	137.0561	119.4888	114.6523	98.9362	91.6790	105.2030	106.4594	124.0682	135.4301	147.0684	(45)
Energy content (annual)											Total = Sum(45)m =	1464.7193	(45)
Distribution loss (46)m = 0.15 x (45)m													

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	22.7790	19.9227	20.5584	17.9233	17.1979	14.8404	13.7518	15.7804	15.9689	18.6102	20.3145	22.0603	(46)

Water storage loss:
Store volume 3.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0212 (51)
Volume factor from Table 2a 3.4200 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 0.2173 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(56)
If cylinder contains dedicated solar storage	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	181.8578	159.9125	167.0537	148.5188	144.6500	127.9663	121.6767	135.2007	135.4895	154.0659	164.4602	177.0661	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	181.8578	159.9125	167.0537	148.5188	144.6500	127.9663	121.6767	135.2007	135.4895	154.0659	164.4602	177.0661	(64)
Total per year (kWh/year) = Sum(64)m =												1817.9180	(64)
Heat gains from water heating, kWh/month	74.4916	65.8377	69.5693	62.9540	62.1201	56.1203	54.4814	58.9781	58.6218	65.2508	68.2545	72.8984	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	123.9858	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.8602	17.6397	14.3455	10.8605	8.1183	6.8539	7.4058	9.6264	12.9205	16.4055	19.1477	20.4122	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	221.3112	223.6078	217.8206	205.5004	189.9485	175.3318	165.5669	163.2704	169.0576	181.3777	196.9297	211.5464	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	35.3986	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	-99.1886	(71)
Water heating gains (Table 5)	100.1232	97.9727	93.5071	87.4362	83.4947	77.9449	73.2277	79.2717	81.4191	87.7027	94.7980	97.9817	(72)
Total internal gains	401.4903	399.4159	385.8690	363.9928	341.7572	320.3263	306.3962	312.3642	323.5929	345.6817	371.0711	390.1360	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	16.2500	11.2829	0.4000	0.7000	0.7700	35.5768	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	35.5768	72.4176	130.4735	214.2750	288.0276	307.0679	287.2558	229.0036	158.9840	88.5001	44.7648	29.0538	(83)
Total gains	437.0671	471.8335	516.3425	578.2678	629.7849	627.3942	593.6520	541.3679	482.5770	434.1818	415.8360	419.1898	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	91.1995	91.4876	91.7775	93.2550	93.5562	95.0920	95.0920	95.4053	94.4717	93.5562	92.9557	92.3629	
alpha	7.0800	7.0992	7.1185	7.2170	7.2371	7.3395	7.3395	7.3604	7.2981	7.2371	7.1970	7.1575	
util living area	0.9987	0.9973	0.9910	0.9543	0.8198	0.5968	0.4373	0.4988	0.7976	0.9769	0.9968	0.9990	(86)
MIT	20.2601	20.3524	20.5300	20.7780	20.9471	20.9953	20.9996	20.9990	20.9681	20.7487	20.4668	20.2451	(87)
Th 2	20.2869	20.2890	20.2911	20.3015	20.3036	20.3142	20.3142	20.3163	20.3099	20.3036	20.2994	20.2952	(88)
util rest of house	0.9982	0.9964	0.9880	0.9397	0.7766	0.5354	0.3695	0.4255	0.7367	0.9667	0.9956	0.9987	(89)
MIT 2	19.2832	19.4196	19.6793	20.0381	20.2531	20.3111	20.3140	20.3158	20.2846	20.0043	19.5953	19.2680	(90)
Living area fraction									fLA = Living area / (4) =			0.4405	(91)
MIT	19.7135	19.8305	20.0540	20.3641	20.5588	20.6125	20.6160	20.6168	20.5857	20.3323	19.9792	19.6984	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7135	19.8305	20.0540	20.3641	20.5588	20.6125	20.6160	20.6168	20.5857	20.3323	19.9792	19.6984	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9956	0.9868	0.9412	0.7932	0.5624	0.3994	0.4579	0.7622	0.9672	0.9949	0.9983	(94)
Useful gains	436.0945	469.7744	509.5330	544.2415	499.5426	352.8315	237.0969	247.8751	367.8201	419.9575	413.6977	418.4846	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	949.5020	916.8524	829.6949	690.6419	531.9730	355.2218	237.2670	248.3092	385.6910	584.4231	778.3941	942.7066	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	381.9751	300.4365	238.2005	105.4083	24.1282	0.0000	0.0000	0.0000	0.0000	122.3625	262.5814	390.0212	(98)
Space heating												1825.1136	(98)
Space heating per m2											(98) / (4) =	22.5601	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
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Not applicable


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9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                      0.0000 (301)
Fraction of space heat from community system                                                               1.0000 (302)
Fraction of heat from community Boilers                                                                    1.0000 (303a)
Fraction of total space heat from community Boilers                                                        1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                           1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                           1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                          1.0500 (306)
Space heating:
Annual space heating requirement                                                                        1825.1136 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                                     1916.3693 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                    0.0000 (308)
Space heating fuel for secondary/supplementary system                                                      0.0000 (309)

Water heating
Annual water heating requirement                                                                        1817.9180 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                                     1908.8139 (310a)
Electricity used for heat distribution                                                                    38.2518 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                                      129.5411 (330a)
Total electricity for the above, kWh/year                                                                129.5411 (331)
Electricity for lighting (calculated in Appendix L)                                                      350.7375 (332)
Total delivered energy for all uses                                                                     4305.4618 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                              Energy      Emission factor          Emissions
                                                                            kWh/year          kg CO2/kWh        kg CO2/year
Efficiency of heat source Boilers                                                                                89.5000 (367a)
Space heating from Boilers                                                 4273.9477              0.2160         923.1727 (367)
Electrical energy for heat distribution                                      38.2518              0.5190          19.8527 (372)
Total CO2 associated with community systems                                                                      943.0254 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                          943.0254 (376)
Pumps and fans                                                              129.5411              0.5190          67.2318 (378)
Energy for lighting                                                         350.7375              0.5190         182.0328 (379)
Total CO2, kg/year                                                                                              1192.2900 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                       14.7400 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                      14.7400 ZC1
Total Floor Area                                                                                  TFA    80.9000
Assumed number of occupants                                                                         N     2.4797
CO2 emission factor in Table 12 for electricity displaced from grid                                EF     0.5190
CO2 emissions from appliances, equation (L14)                                                           16.2107 ZC2
CO2 emissions from cooking, equation (L16)                                                               2.2066 ZC3
Total CO2 emissions                                                                                     33.1573 ZC4
Residual CO2 emissions offset from biofuel CHP                                                           0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                 0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                          0.0000 ZC7
Net CO2 emissions                                                                                       33.1573 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                                   Area        Storey height              Volume
                                                                                   (m2)                 (m)                 (m3)
Ground floor                                                                    80.9000 (1b)    x     2.5000 (2b)    =    202.2500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          80.9000                                                        (4)
Dwelling volume                                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    202.2500 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                       main         secondary           other             total        m3 per hour
                                                    heating           heating
Number of chimneys                                        0     +           0     +         0     =          0 * 40 =      0.0000 (6a)
Number of open flues                                      0     +           0     +         0     =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                  3 * 10 =     30.0000 (7a)
Number of passive vents                                                                                      0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                 0 * 40 =      0.0000 (7c)

                                                                                                          Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                           30.0000 / (5) =      0.1483 (8)
Pressure test                                                                                                                 Yes
Measured/design AP50                                                                                                       5.0000
Infiltration rate                                                                                                          0.3983 (18)
Number of sides sheltered                                                                                                       3 (19)

Shelter factor                                                                             (20) =  1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                               (21) = (18) x (20)   =      0.3087 (21)


                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed     5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor    1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
               0.3936    0.3859    0.3782    0.3396    0.3319    0.2933    0.2933    0.2856    0.3087    0.3319    0.3473    0.3627 (22b)
Effective ac   0.5775    0.5745    0.5715    0.5577    0.5551    0.5430    0.5430    0.5408    0.5476    0.5551    0.5603    0.5658 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                           Gross      Openings       NetArea      U-value         A x U       K-value         A x K
                                                     m2            m2            m2       W/m2K           W/K        kJ/m2K          kJ/K
TER Opaque door                                                              2.1200       1.0000        2.1200                              (26)
TER Opening Type (Uw = 1.40)                                                16.2500       1.3258       21.5436                              (27)
External Wall                                   39.7000       16.2500       23.4500       0.1800        4.2210                              (29a)
Wall to CA                                      41.3000        2.1200       39.1800       0.1800        7.0524                              (29a)
Total net area of external elements Aum(A, m2)                              81.0000                                                     (31)
Fabric heat loss, W/K = Sum (A x U)                                      (26)...(30) + (32) =       34.9370                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                            250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                     6.7965 (36)
Total fabric heat loss                                                                                       (33) + (36) =    41.7335 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m         38.5412   38.3404   38.1437   37.2194   37.0465   36.2414   36.2414   36.0924   36.5515   37.0465   37.3963   37.7620 (38)
Heat transfer coeff
              80.2746   80.0739   79.8771   78.9528   78.7799   77.9749   77.9749   77.8258   78.2850   78.7799   79.1297   79.4955 (39)
Average = Sum(39)m / 12 =                                                                                                     78.9520 (39)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.9923    0.9898    0.9874    0.9759    0.9738    0.9638    0.9638    0.9620    0.9677    0.9738    0.9781    0.9826 (40)
HLP (average)                                                                                                                  0.9759 (40)
Days in month
                   31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                              2.4797 (42)
Average daily hot water use (litres/day)                                                                                      93.0933 (43)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             102.4026   98.6788   94.9551   91.2314   87.5077   83.7839   83.7839   87.5077   91.2314   94.9551   98.6788  102.4026 (44)
Energy conte 151.8601  132.8178  137.0561  119.4888  114.6523   98.9362   91.6790  105.2030  106.4594  124.0682  135.4301  147.0684 (45)
Energy content (annual)                                                                                Total = Sum(45)m =   1464.7193 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7790   19.9227   20.5584   17.9233   17.1979   14.8404   13.7518   15.7804   15.9689   18.6102   20.3145   22.0603 (46)
Water storage loss:
Store volume                                                                                                                   3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  0.2602 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                     0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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               4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
               4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (64)
                                                                                 Total per year (kWh/year) = Sum(64)m =    1789.8952 (64)
Heat gains from water heating, kWh/month
              72.5876    64.1179    67.6653    61.1114    60.2160    54.2777    52.5774    57.0741    56.7792    63.3468    66.4119    70.9944 (65)


------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.8602    17.6397    14.3455    10.8605     8.1183     6.8539     7.4058     9.6264    12.9205    16.4055    19.1477    20.4122 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             221.3112   223.6078   217.8206   205.5004   189.9485   175.3318   165.5669   163.2704   169.0576   181.3777   196.9297   211.5464 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886 (71)
Water heating gains (Table 5)
              97.5640    95.4136    90.9480    84.8770    80.9355    75.3857    70.6685    76.7125    78.8600    85.1436    92.2388    95.4225 (72)
Total internal gains
             401.9312   399.8567   386.3098   364.4337   342.1981   320.7671   306.8371   312.8051   324.0338   346.1226   371.5120   390.5769 (73)


------------------------------------------------------------------------------------------------
6. Solar gains
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[Jan]                                     Area        Solar flux                g                FF             Access              Gains
                                            m2          Table 6a    Specific data    Specific data             factor                  W
                                                            W/m2      or Table 6b      or Table 6c           Table 6d
------------------------------------------------------------------------------------------------
Northeast                              16.2500           11.2829           0.6300           0.7000             0.7700            56.0335 (75)
------------------------------------------------------------------------------------------------

Solar gains    56.0335   114.0577   205.4958   337.4831   453.6435   483.6320   452.4278   360.6807   250.3998   139.3876    70.5046    45.7598 (83)
Total gains   457.9646   513.9145   591.8056   701.9168   795.8416   804.3991   759.2649   673.4858   574.4336   485.5102   442.0166   436.3366 (84)


------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           69.9854    70.1609    70.3337    71.1571    71.3133    72.0495    72.0495    72.1875    71.7642    71.3133    70.9980    70.6714
alpha          5.6657     5.6774     5.6889     5.7438     5.7542     5.8033     5.8033     5.8125     5.7843     5.7542     5.7332     5.7114
util living area
               0.9985     0.9967     0.9892     0.9484     0.8145     0.6050     0.4494     0.5252     0.8251     0.9793     0.9968     0.9989 (86)

MIT           19.9442    20.0709    20.3147    20.6527    20.8987    20.9852    20.9977    20.9948    20.9205    20.5876    20.2099    19.9227 (87)
Th 2          20.0898    20.0919    20.0939    20.1034    20.1052    20.1136    20.1136    20.1151    20.1104    20.1052    20.1016    20.0978 (88)
util rest of house
               0.9980     0.9957     0.9853     0.9307     0.7638     0.5278     0.3602     0.4275     0.7561     0.9693     0.9955     0.9985 (89)
MIT 2         18.6710    18.8575    19.2130    19.6974    20.0099    20.1042    20.1127    20.1130    20.0467    19.6165    19.0681    18.6455 (90)
Living area fraction                                                                              fLA = Living area / (4) =       0.4405 (91)
MIT           19.2319    19.3921    19.6984    20.1183    20.4015    20.4923    20.5026    20.5015    20.4317    20.0443    19.5711    19.2082 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT  19.2319    19.3921    19.6984    20.1183    20.4015    20.4923    20.5026    20.5015    20.4317    20.0443    19.5711    19.2082 (93)


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8. Space heating requirement
------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9973     0.9945     0.9832     0.9311     0.7817     0.5615     0.3996     0.4707     0.7832     0.9684     0.9945     0.9980 (94)
Useful gains 456.7484   511.0930   581.8757   653.5401   622.0975   451.6392   303.4001   316.9972   449.8712   470.1873   439.5640   435.4503 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1198.6538  1160.4357  1054.2477   885.7139   685.5003   459.4499   304.3066   319.2000   495.6754   744.0221   986.8368  1193.0819 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             551.9776   436.3583   351.4448   167.1651    47.1717     0.0000     0.0000     0.0000     0.0000   203.7331   394.0364   563.6779 (98)
Space heating                                                                                                                2715.5650 (98)
Space heating per m2                                                                                          (98) / (4) =     33.5669 (99)


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8c. Space cooling requirement
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Not applicable


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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9a. Energy requirements - Individual heating systems, including micro-CHP
------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                      0.0000 (201)
Fraction of space heat from main system(s)                                                                                 1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                          93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                    0.0000 (208)
Space heating requirement                                                                                               2904.3476 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
             551.9776   436.3583   351.4448   167.1651    47.1717     0.0000     0.0000     0.0000     0.0000   203.7331   394.0364   563.6779 (98)
Space heating efficiency (main heating system 1)
              93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
             590.3504   466.6934   375.8768   178.7862    50.4510     0.0000     0.0000     0.0000     0.0000   217.8964   421.4293   602.8641 (211)
Water heating requirement
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (64)
Efficiency of water heater                                                                                                79.8000 (216)
(217)m        87.6173    87.3885    86.7871    85.1716    82.2206    79.8000    79.8000    79.8000    79.8000    85.6015    87.0953    87.7174 (217)
Fuel for water heating, kWh/month
             204.8427   180.5303   189.7444   171.6717   173.0345   157.4725   149.4946   166.4419   166.9000   177.2001   186.1834   199.1464 (219)
Water heating fuel used                                                                                                 2122.6626 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                        2904.3476 (211)
Space heating fuel - secondary                                                                                             0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                   30.0000 (230c)
   main heating flue fan                                                                                                  45.0000 (230e)
Total electricity for the above, kWh/year                                                                                 75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                      350.7375 (232)
Total delivered energy for all uses                                                                                     5452.7477 (238)


------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
------------------------------------------------------------------------------------------------
                                                                        Energy      Emission factor        Emissions
                                                                      kWh/year          kg CO2/kWh      kg CO2/year
Space heating - main system 1                                        2904.3476              0.2160         627.3391 (261)
Space heating - secondary                                               0.0000              0.0000           0.0000 (263)
Water heating (other fuel)                                           2122.6626              0.2160         458.4951 (264)
Space and water heating                                                                                   1085.8342 (265)
Pumps and fans                                                         75.0000              0.5190          38.9250 (267)
Energy for lighting                                                   350.7375              0.5190         182.0328 (268)
Total CO2, kg/m2/year                                                                                     1306.7920 (272)
Emissions per m2 for space and water heating                                                                13.4219 (272a)
Fuel factor (mains gas)                                                                                      1.0000
Emissions per m2 for lighting                                                                                2.2501 (272b)
Emissions per m2 for pumps and fans                                                                          0.4811 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.4219 * 1.00) + 2.2501 + 0.4811, rounded to 2 d.p.           16.1500 (273)
```

Property Reference	008 Block A2-2B4P-03281	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	008 Block A2-2B4P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	86 B	**DER**	12.75	**TER**	13.65
Environmental	91 B	**% DER<TER**	6.56		
CO_2 Emissions (t/year)	0.80	**DFEE**	32.53	**TFEE**	31.97
General Requirements Compliance	Fail	**% DFEE<TFEE**	-1.75		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 77 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.75 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)32.5 kWh/m²/yrFail
Excess energy =0.5 kWh/m²/yr  (1.6%)
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element          Average                 Highest
External wall    0.18 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall       0.00 (max. 0.20)         -                        OK
Floor            (no floor)
Roof             (no roof)
Openings         1.34 (max. 2.00)        1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:          3.00 (design value)
Maximum                                  10.0                                                 OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                     Community heating scheme                             -

Secondary heating system:                None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                        Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                            OK
Primary pipework insulated:              No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                  Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                      No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                  75%                                                  OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                      0.44
Maximum                                  1.5                                                  OK
MVHR efficiency:                         91%
Minimum:                                 70%                                                  OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):             Medium                                               OK
Based on:
Overshading:                             Average
Windows facing South:                    8.10 m², No overhang
Windows facing South West:               10.13 m², No overhang
Air change rate:                         2.00 ach
Blinds/curtains:                         None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                       0.00 W/m²K
Door U-value                             0.82 W/m²K
Air permeability                         3.0 m³/m²h




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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-------------------------------------------------------------------------------------------------
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                                            Area          Storey height              Volume
                                                                                            (m2)                    (m)                (m3)
Ground floor                                                                           76.8000 (1b)     x       2.5000 (2b)     =    192.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              76.8000                                                                   (4)
Dwelling volume                                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    192.0000 (5)


-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                              main           secondary             other               total        m3 per hour
                                                           heating             heating
Number of chimneys                                               0       +           0      +           0      =            0 * 40 =      0.0000 (6a)
Number of open flues                                             0       +           0      +           0      =            0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                 0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                     0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                0 * 40 =      0.0000 (7c)

                                                                                                                      Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                    0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                        Yes
Measured/design AP50                                                                                                              3.0000
Infiltration rate                                                                                                                 0.1500 (18)
Number of sides sheltered                                                                                                              2 (19)

Shelter factor                                                                                  (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                     (21) = (18) x (20)  =      0.1275 (21)


                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                        0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                     77.3500 (23c)

Effective ac    0.2758     0.2726     0.2694     0.2535     0.2503     0.2344     0.2344     0.2312     0.2408     0.2503     0.2567     0.2631 (25)



-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                       Gross        Openings          NetArea        U-value           A x U        K-value           A x K
                                                 m2              m2               m2          W/m2K             W/K         kJ/m2K            kJ/K
Window Double-Glazed (Uw = 1.40)                                            18.2300         1.3258         24.1686                                   (27)
Door                                                                         2.1200         0.8200          1.7384                                   (26)
External Wall                               40.0000         18.2300         21.7700         0.1800          3.9186                                   (29a)
Wall to CA                                  12.8000          2.1200         10.6800         0.1671          1.7843                                   (29a)
Total net area of external elements Aum(A, m2)                              52.8000                                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                              (26)...(30) + (32) =      31.6099                                   (33)
Party Wall 1                                                                36.7500         0.0000          0.0000                                   (32)
Party Floor 1                                                               76.8000                                                                  (32d)
Party Ceilings 1                                                            76.8000                                                                  (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                               250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                        8.0106 (36)
Total fabric heat loss                                                                                            (33) + (36) =  39.6205 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          17.4755    17.2735    17.0716    16.0618    15.8598    14.8500    14.8500    14.6480    15.2539    15.8598    16.2637    16.6676 (38)
Heat transfer coeff
               57.0959    56.8940    56.6920    55.6822    55.4803    54.4705    54.4705    54.2685    54.8744    55.4803    55.8842    56.2881 (39)
Average = Sum(39)m / 12 =                                                                                                        55.6317 (39)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.7434     0.7408     0.7382     0.7250     0.7224     0.7093     0.7093     0.7066     0.7145     0.7224     0.7277     0.7329 (40)
HLP (average)                                                                                                                     0.7244 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)



-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                 2.3993 (42)
Average daily hot water use (litres/day)                                                                                         91.1843 (43)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              100.3028    96.6554    93.0080    89.3606    85.7133    82.0659    82.0659    85.7133    89.3606    93.0080    96.6554   100.3028 (44)
Energy conte  148.7461   130.0943   134.2456   117.0386   112.3013    96.9075    89.7991   103.0457   104.2764   121.5241   132.6531   144.0527 (45)
Energy content (annual)                                                                                     Total = Sum(45)m =  1434.6845 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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               22.3119    19.5141    20.1368    17.5558    16.8452    14.5361    13.4699    15.4569    15.6415    18.2286    19.8980    21.6079 (46)
Water storage loss:
Store volume                                                                                                                      3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                      0.0212 (51)
  Volume factor from Table 2a                                                                                                     3.4200 (52)
  Temperature factor from Table 2b                                                                                                1.0000 (53)
Enter (49) or (54) in (55)                                                                                                        0.2173 (55)
Total storage loss
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              178.7438   157.1890   164.2433   146.0686   142.2990   125.9375   119.7967   133.0434   133.3064   151.5218   161.6831   174.0503 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                      Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              178.7438   157.1890   164.2433   146.0686   142.2990   125.9375   119.7967   133.0434   133.3064   151.5218   161.6831   174.0503 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =  1787.8832 (64)
Heat gains from water heating, kWh/month
               73.4562    64.9321    68.6348    62.1394    61.3383    55.4458    53.8563    58.2609    57.8959    64.4049    67.3312    71.8957 (65)



-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               18.9555    16.8361    13.6920    10.3657     7.7485     6.5416     7.0685     9.1878    12.3319    15.6582    18.2754    19.4823 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              212.6229   214.8293   209.2693   197.4328   182.4914   168.4485   159.0670   156.8607   162.4206   174.2571   189.1986   203.2414 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736 (71)
Water heating gains (Table 5)
               98.7315    96.6252    92.2511    86.3047    82.4440    77.0080    72.3876    78.3076    80.4110    86.5658    93.5155    96.6340 (72)
Total internal gains
              389.3000   387.2806   374.2026   353.0933   331.6740   310.9883   297.5131   303.3462   314.1537   335.4712   359.9796   378.3478 (73)



-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------

[Jan]                                       Area        Solar flux                 g               FF            Access            Gains
                                              m2          Table 6a     Specific data    Specific data            factor                W
                                                              W/m2       or Table 6b      or Table 6c          Table 6d
-------------------------------------------------------------------------------------------------
South                                     8.1000           46.7521            0.4000           0.7000            0.7700          73.4813 (78)
Southwest                                10.1300           36.7938            0.4000           0.7000            0.7700          72.3229 (79)
-------------------------------------------------------------------------------------------------


Solar gains   145.8042   243.5361   321.8538   382.1090   414.4761   405.9894   393.6679   370.0578   342.6482   265.9559   173.7266   125.3880 (83)
Total gains   535.1042   630.8167   696.0564   735.2023   746.1501   716.9777   691.1811   673.4040   656.8019   601.4270   533.7062   503.7357 (84)



-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                     21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            93.4100    93.7416    94.0756    95.7816    96.1303    97.9124    97.9124    98.2768    97.1917    96.1303    95.4355    94.7506
alpha           7.2273     7.2494     7.2717     7.3854     7.4087     7.5275     7.5275     7.5518     7.4794     7.4087     7.3624     7.3167
util living area
                0.9932     0.9782     0.9388     0.8390     0.6770     0.4851     0.3467     0.3706     0.5725     0.8620     0.9794     0.9953 (86)

MIT            20.4426    20.6050    20.7772    20.9245    20.9856    20.9990    20.9999    20.9999    20.9965    20.9223    20.6634    20.4121 (87)
Th 2           20.3026    20.3049    20.3072    20.3188    20.3211    20.3327    20.3327    20.3350    20.3280    20.3211    20.3165    20.3118 (88)
util rest of house
                0.9912     0.9723     0.9241     0.8080     0.6323     0.4351     0.2941     0.3171     0.5184     0.8279     0.9728     0.9939 (89)
MIT 2          19.5612    19.7958    20.0370    20.2377    20.3084    20.3320    20.3326    20.3349    20.3256    20.2407    19.8908    19.5245 (90)
Living area fraction                                                                               fLA = Living area / (4) =      0.4583 (91)
MIT            19.9652    20.1667    20.3763    20.5525    20.6188    20.6377    20.6385    20.6397    20.6331    20.5531    20.2449    19.9313 (92)
Temperature adjustment                                                                                                            0.0000
adjusted MIT   19.9652    20.1667    20.3763    20.5525    20.6188    20.6377    20.6385    20.6397    20.6331    20.5531    20.2449    19.9313 (93)



-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9900     0.9710     0.9257     0.8191     0.6522     0.4580     0.3182     0.3416     0.5431     0.8402     0.9720     0.9930 (94)
Useful gains  529.7792   612.5171   644.3329   602.1931   486.6093   328.3710   219.9508   230.0369   356.7317   505.3380   518.7837   500.2009 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              894.4200   868.5809   786.6730   648.8366   494.8177   328.8758   219.9779   230.0825   358.5002   552.2015   734.5917   885.4835 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              271.2928   172.0749   105.9011    33.5833     6.1070     0.0000     0.0000     0.0000     0.0000    34.8664   155.3817   286.6503 (98)
Space heating                                                                                                                  1065.8575 (98)
Space heating per m2                                                                                              (98) / (4) =   13.8784 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                      0.0000 (301)
Fraction of space heat from community system                                                               1.0000 (302)
Fraction of heat from community Boilers                                                                    1.0000 (303a)
Fraction of total space heat from community Boilers                                                        1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                           1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                           1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                          1.0500 (306)
Space heating:
Annual space heating requirement                                                                        1065.8575 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                                     1119.1504 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                    0.0000 (308)
Space heating fuel for secondary/supplementary system                                                      0.0000 (309)

Water heating
Annual water heating requirement                                                                        1787.8832 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                                     1877.2773 (310a)
Electricity used for heat distribution                                                                    29.9643 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
   mechanical ventilation fans (SFP =       0.5500)                                                      128.8320 (330a)
Total electricity for the above, kWh/year                                                                 128.8320 (331)
Electricity for lighting (calculated in Appendix L)                                                       334.7598 (332)
Total delivered energy for all uses                                                                      3460.0195 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                                          Energy      Emission factor            Emissions
                                                                                        kWh/year          kg CO2/kWh          kg CO2/year
Efficiency of heat source Boilers                                                                                                89.5000 (367a)
Space heating from Boilers                                                             3347.9639              0.2160            723.1602 (367)
Electrical energy for heat distribution                                                  29.9643              0.5190             15.5515 (372)
Total CO2 associated with community systems                                                                                     738.7117 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                                         738.7117 (376)
Pumps and fans                                                                          128.8320              0.5190             66.8638 (378)
Energy for lighting                                                                     334.7598              0.5190            173.7403 (379)
Total CO2, kg/year                                                                                                              979.3158 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                      12.7500 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                              12.7500 ZC1
Total Floor Area                                                                                                      TFA        76.8000
Assumed number of occupants                                                                                             N         2.3993
CO2 emission factor in Table 12 for electricity displaced from grid                                                    EF         0.5190
CO2 emissions from appliances, equation (L14)                                                                                    16.4057 ZC2
CO2 emissions from cooking, equation (L16)                                                                                        2.2993 ZC3
Total CO2 emissions                                                                                                              31.4550 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                                    0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                          0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                                   0.0000 ZC7
Net CO2 emissions                                                                                                                31.4550 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                              Area        Storey height              Volume
                                                                              (m2)                  (m)                (m3)
Ground floor                                                           76.8000 (1b)    x      2.5000 (2b)     =   192.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)           76.8000                                                 (4)
Dwelling volume                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   192.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                       main          secondary            other            total       m3 per hour
                                                    heating            heating
Number of chimneys                                        0      +           0      +         0      =        0 * 40 =      0.0000 (6a)
Number of open flues                                      0      +           0      +         0      =        0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                   3 * 10 =     30.0000 (7a)
Number of passive vents                                                                                       0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                  0 * 40 =      0.0000 (7c)

                                                                                                        Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                      30.0000 / (5) =      0.1563 (8)
Pressure test                                                                                                            Yes
Measured/design AP50                                                                                                  5.0000
Infiltration rate                                                                                                     0.4063 (18)
Number of sides sheltered                                                                                                  2 (19)

Shelter factor                                                                      (20) =  1  -  [0.075 x (19)]  =   0.8500 (20)
Infiltration rate adjusted to include shelter factor                                        (21) = (18) x (20)    =   0.3453 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.4403     0.4316     0.4230     0.3798     0.3712     0.3280     0.3280     0.3194     0.3453     0.3712     0.3885     0.4057 (22b)
Effective ac     0.5969     0.5932     0.5895     0.5721     0.5689     0.5538     0.5538     0.5510     0.5596     0.5689     0.5755     0.5823 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                         Gross      Openings       NetArea       U-value         A x U       K-value         A x K
                                                   m2            m2            m2         W/m2K           W/K        kJ/m2K          kJ/K
TER Opaque door                                                            2.1200        1.0000        2.1200                                (26)
TER Opening Type (Uw = 1.40)                                              17.0600        1.3258       22.6174                                (27)
External Wall                                 40.0000       17.0600       22.9400        0.1800        4.1292                                (29a)
Wall to CA                                    12.8000        2.1200       10.6800        0.1800        1.9224                                (29a)
Total net area of external elements Aum(A, m2)                            52.8000                                                            (31)
Fabric heat loss, W/K = Sum (A x U)                                 (26)...(30) + (32) =  30.7890                                            (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                             250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                      5.5713 (36)
Total fabric heat loss                                                                                         (33) + (36) =   36.3603 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m        37.8209    37.5824    37.3487    36.2508    36.0454    35.0892    35.0892    34.9122    35.4575    36.0454    36.4610    36.8954 (38)
Heat transfer coeff
             74.1812    73.9427    73.7090    72.6112    72.4058    71.4496    71.4496    71.2725    71.8179    72.4058    72.8213    73.2557 (39)
Average = Sum(39)m / 12 =                                                                                                     72.6102 (39)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP           0.9659     0.9628     0.9598     0.9455     0.9428     0.9303     0.9303     0.9280     0.9351     0.9428     0.9482     0.9539 (40)
HLP (average)                                                                                                                  0.9454 (40)
Days in month
                  31         28         31         30         31         30         31         31         30         31         30         31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                              2.3993 (42)
Average daily hot water use (litres/day)                                                                                      91.1843 (43)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
            100.3028    96.6554    93.0080    89.3606    85.7133    82.0659    82.0659    85.7133    89.3606    93.0080    96.6554   100.3028 (44)
Energy conte 148.7461  130.0943   134.2456   117.0386   112.3013    96.9075    89.7991   103.0457   104.2764   121.5241   132.6531   144.0527 (45)
Energy content (annual)                                                                           Total = Sum(45)m =  1434.6845 (45)
Distribution loss  (46)m = 0.15 x (45)m
             22.3119    19.5141    20.1368    17.5558    16.8452    14.5361    13.4699    15.4569    15.6415    18.2286    19.8980    21.6079 (46)
Water storage loss:
Store volume                                                                                                                   3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  0.2602 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                     0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
                 4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               176.3638   155.0393   161.8633   143.7654   139.9190   123.6343   117.4167   130.6634   131.0032   149.1418   159.3799   171.6703 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                 Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
               176.3638   155.0393   161.8633   143.7654   139.9190   123.6343   117.4167   130.6634   131.0032   149.1418   159.3799   171.6703 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =  1759.8604 (64)
Heat gains from water heating, kWh/month
                71.5522    63.2123    66.7308    60.2968    59.4343    53.6032    51.9523    56.3568    56.0533    62.5009    65.4886    69.9916 (65)
```

```
-----------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670   119.9670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                18.9570    16.8374    13.6931    10.3666     7.7491     6.5421     7.0690     9.1886    12.3329    15.6594    18.2769    19.4839 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               212.6229   214.8293   209.2693   197.4328   182.4914   168.4485   159.0670   156.8607   162.4206   174.2571   189.1986   203.2414 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967    34.9967 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736   -95.9736 (71)
Water heating gains (Table 5)
                96.1723    94.0660    89.6920    83.7455    79.8849    74.4489    69.8284    75.7484    77.8519    84.0066    90.9563    94.0748 (72)
Total internal gains
               389.7423   387.7228   374.6445   353.5350   332.1155   311.4296   297.9545   303.7878   314.5955   335.9132   360.4219   378.7902 (73)
```

```
-----------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------

[Jan]                                 Area      Solar flux              g             FF           Access             Gains
                                        m2        Table 6a   Specific data  Specific data          factor                 W
                                                      W/m2     or Table 6b    or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------
South                                7.5800        46.7521          0.6300         0.7000          0.7700          108.3033 (78)
Southwest                            9.4800        36.7938          0.6300         0.7000          0.7700          106.5995 (79)
-----------------------------------------------------------------------------------------------

Solar gains    214.9028   358.9514   474.3852   563.1967   610.9034   598.3949   580.2339   545.4343   505.0345   391.9962   256.0580   184.8110 (83)
Total gains    604.6452   746.6741   849.0296   916.7316   943.0188   909.8245   878.1885   849.2221   819.6300   727.9094   616.4799   563.6012 (84)
```

```
-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             71.8960    72.1279    72.3566    73.4506    73.6590    74.6447    74.6447    74.8302    74.2619    73.6590    73.2387    72.8043
alpha            5.7931     5.8085     5.8238     5.8967     5.9106     5.9763     5.9763     5.9887     5.9508     5.9106     5.8826     5.8536
util living area
                 0.9919     0.9741     0.9321     0.8362     0.6832     0.4985     0.3575     0.3853     0.5923     0.8694     0.9781     0.9944 (86)

MIT             20.1914    20.4136    20.6486    20.8577    20.9630    20.9952    20.9994    20.9991    20.9871    20.8473    20.4805    20.1500 (87)
Th 2            20.1118    20.1145    20.1170    20.1290    20.1313    20.1418    20.1418    20.1437    20.1377    20.1313    20.1267    20.1220 (88)
util rest of house
                 0.9895     0.9669     0.9146     0.8005     0.6290     0.4335     0.2880     0.3140     0.5233     0.8315     0.9708     0.9926 (89)
MIT 2           19.0469    19.3671    19.6955    19.9774    20.0990    20.1389    20.1416    20.1434    20.1290    19.9734    19.4756    18.9946 (90)
Living area fraction                                                                             fLA = Living area / (4) =     0.4583 (91)
MIT             19.5714    19.8467    20.1323    20.3809    20.4950    20.5314    20.5348    20.5356    20.5223    20.3739    19.9362    19.5242 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT    19.5714    19.8467    20.1323    20.3809    20.4950    20.5314    20.5348    20.5356    20.5223    20.3739    19.9362    19.5242 (93)
```

```
-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9876     0.9643     0.9149     0.8114     0.6522     0.4632     0.3199     0.3467     0.5545     0.8430     0.9688     0.9911 (94)
Useful gains   597.1174   719.9979   776.8029   743.8777   615.0570   421.4281   280.9266   294.4151   454.5255   613.6082   597.2456   558.5852 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1132.8533  1105.2035  1004.8251   833.6414   636.8083   423.7940   281.1381   294.7559   461.2375   707.6874   934.7469  1122.5833 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               398.5875   258.8582   169.6485    64.6299    16.1830     0.0000     0.0000     0.0000     0.0000    69.9949   243.0010   419.6146 (98)
Space heating                                                                                                                1640.5175 (98)
Space heating per m2                                                                                         (98) / (4) =    21.3609 (99)
```

```
-----------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------
Not applicable
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
-----------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                       0.0000 (201)
Fraction of space heat from main system(s)                                                                                  1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                           93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                     0.0000 (208)
Space heating requirement                                                                                                1754.5642 (211)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               398.5875   258.8582   169.6485    64.6299    16.1830     0.0000     0.0000     0.0000     0.0000    69.9949   243.0010   419.6146 (98)
Space heating efficiency (main heating system 1)
                93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
               426.2968   276.8537   181.4422    69.1229    17.3080     0.0000     0.0000     0.0000     0.0000    74.8609   259.8941   448.7857 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               176.3638   155.0393   161.8633   143.7654   139.9190   123.6343   117.4167   130.6634   131.0032   149.1418   159.3799   171.6703 (64)
Efficiency of water heater                                                                                                 79.8000 (216)
(217)m          86.9248    86.1719    84.9392    82.8374    80.7902    79.8000    79.8000    79.8000    79.8000    82.9319    85.9359    87.1089 (217)
Fuel for water heating, kWh/month
               202.8924   179.9186   190.5638   173.5512   173.1880   154.9302   147.1388   163.7386   164.1644   179.8365   185.4636   197.0755 (219)
Water heating fuel used                                                                                                  2112.4615 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                         1754.5642 (211)
Space heating fuel - secondary                                                                                              0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                    30.0000 (230c)
   main heating flue fan                                                                                                   45.0000 (230e)
Total electricity for the above, kWh/year                                                                                  75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                       334.7862 (232)
Total delivered energy for all uses                                                                                      4276.8119 (238)
```

```
-----------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------
                                                                                   Energy     Emission factor             Emissions
                                                                                 kWh/year           kg CO2/kWh           kg CO2/year
Space heating - main system 1                                                   1754.5642               0.2160              378.9859 (261)
Space heating - secondary                                                          0.0000               0.0000                0.0000 (263)
Water heating (other fuel)                                                      2112.4615               0.2160              456.2917 (264)
Space and water heating                                                                                                     835.2776 (265)
Pumps and fans                                                                    75.0000               0.5190               38.9250 (267)
Energy for lighting                                                              334.7862               0.5190              173.7540 (268)
Total CO2, kg/m2/year                                                                                                      1047.9566 (272)
Emissions per m2 for space and water heating                                                                                 10.8760 (272a)
Fuel factor (mains gas)                                                                                                       1.0000
Emissions per m2 for lighting                                                                                                 2.2624 (272b)
Emissions per m2 for pumps and fans                                                                                           0.5068 (272c)
Target Carbon Dioxide Emission Rate (TER) = (10.8760 * 1.00) + 2.2624 + 0.5068, rounded to 2 d.p.                          13.6500 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	009 Block B3-1B2P-03281	**Issued on Date**	22/07/2020
Assessment Reference	1B2P no cooling	**Prop Type Ref**	Top floor
Property	009 Block B3-1B2P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	82 B	**DER**	20.91	**TER**	23.31
Environmental	87 B	**% DER<TER**	10.30		
CO_2 Emissions (t/year)	0.85	**DFEE**	59.05	**TFEE**	71.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.46		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 52 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 23.31 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.91 kgCO□/m²OK
------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)71.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)59.1 kWh/m²/yrOK
------------------------------------------------------------------------------------------------
2 Fabric U-values
Element        Average              Highest
External wall  0.18 (max. 0.30)     0.18 (max. 0.70)         OK
Party wall     0.00 (max. 0.20)      -                       OK
Floor          (no floor)
Roof           0.10 (max. 0.20)     0.10 (max. 0.35)         OK
Openings       1.31 (max. 2.00)     1.40 (max. 3.30)         OK
------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:     3.00 (design value)
Maximum                             10.0                                            OK
------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                Community heating scheme                        -

Secondary heating system:           None
------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                   Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                     OK
Primary pipework insulated:         No primary pipework
------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:             Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                 No cylinderstat


------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                             75%                                             OK
------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                 0.42
Maximum                             1.5                                             OK
MVHR efficiency:                    91%
Minimum:                            70%                                             OK
------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):        Slight                                          OK
Based on:
Overshading:                        Average
Windows facing North East:          7.98 m², No overhang
Windows facing North West:          3.00 m², No overhang
Air change rate:                    2.00 ach
Blinds/curtains:                    None
------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                  0.00 W/m²K
Roof U-value                        0.10 W/m²K
Door U-value                        0.82 W/m²K
Air permeability                    3.0 m³/m²h


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-------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------


-------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------
                                                                         Area          Storey height              Volume
                                                                         (m2)                    (m)                (m3)
Ground floor                                                          51.6000 (1b)     x      2.5000 (2b)     =    129.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)         51.6000                                                     (4)
Dwelling volume                                                             (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    129.0000 (5)


-------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------
                                                     main         secondary           other               total       m3 per hour
                                                  heating           heating
Number of chimneys                                      0      +          0      +        0      =        0 * 40 =       0.0000 (6a)
Number of open flues                                    0      +          0      +        0      =        0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                               0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                   0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                              0 * 40 =       0.0000 (7c)

                                                                                                        Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                          0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                Yes
Measured/design AP50                                                                                                      3.0000
Infiltration rate                                                                                                         0.1500 (18)
Number of sides sheltered                                                                                                      2 (19)

Shelter factor                                                                  (20) =  1  -  [0.075 x (19)]  =          0.8500 (20)
Infiltration rate adjusted to include shelter factor                                   (21) = (18) x (20)     =          0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                            77.3500 (23c)

Effective ac     0.2758     0.2726     0.2694     0.2535     0.2503     0.2344     0.2344     0.2312     0.2408     0.2503     0.2567     0.2631 (25)


-------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------
Element                                       Gross      Openings       NetArea     U-value       A x U      K-value       A x K
                                                 m2            m2            m2      W/m2K         W/K      kJ/m2K        kJ/K
Window Double-Glazed (Uw = 1.40)                                        10.9800      1.3258     14.5568                          (27)
Door                                                                     2.1200      0.8200      1.7384                          (26)
External Wall                               42.9000       10.9800       31.9200      0.1800      5.7456                          (29a)
Wall to CA                                  20.1000        2.1200       17.9800      0.1671      3.0039                          (29a)
External Roof 1                             51.6000                     51.6000      0.1000      5.1600                          (30)
Total net area of external elements Aum(A, m2)                         114.6000                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =    30.2047                      (33)
Party Wall 1                                                            22.8000      0.0000      0.0000                          (32)
Party Floor 1                                                           51.6000                                                  (32d)
Party Ceilings 1                                                        51.6000                                                  (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                       250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                               13.6312 (36)
Total fabric heat loss                                                                                   (33) + (36) =    43.8359 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           11.7413    11.6056    11.4700    10.7915    10.6558     9.9773     9.9773     9.8417    10.2487    10.6558    10.9272    11.1986 (38)
Heat transfer coeff
                55.5773    55.4416    55.3059    54.6274    54.4917    53.8133    53.8133    53.6776    54.0846    54.4917    54.7631    55.0345 (39)
Average = Sum(39)m / 12 =                                                                                                54.5935 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.0771     1.0744     1.0718     1.0587     1.0560     1.0429     1.0429     1.0403     1.0482     1.0560     1.0613     1.0666 (40)
HLP (average)                                                                                                             1.0580 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)


-------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                         1.7373 (42)
Average daily hot water use (litres/day)                                                                                 75.4602 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                83.0062    79.9878    76.9694    73.9510    70.9326    67.9141    67.9141    70.9326    73.9510    76.9694    79.9878    83.0062 (44)
Energy conte   123.0958   107.6603   111.0958    96.8560    92.9357    80.1964    74.3138    85.2761    86.2946   100.5680   109.7779   119.2117 (45)
Energy content (annual)                                                                                Total = Sum(45)m =  1187.2821 (45)
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
Distribution loss  (46)m = 0.15 x (45)m
                18.4644    16.1491    16.6644    14.5284    13.9404    12.0295    11.1471    12.7914    12.9442    15.0852    16.4667    17.8818 (46)
Water storage loss:
Store volume                                                                                                              3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                              0.0212 (51)
  Volume factor from Table 2a                                                                                             3.4200 (52)
  Temperature factor from Table 2b                                                                                        1.0000 (53)
Enter (49) or (54) in (55)                                                                                                0.2173 (55)
Total storage loss
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                 6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               153.0935   134.7550   141.0935   125.8861   122.9334   109.2264   104.3115   115.2738   115.3246   130.5657   138.8079   149.2094 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
               153.0935   134.7550   141.0935   125.8861   122.9334   109.2264   104.3115   115.2738   115.3246   130.5657   138.8079   149.2094 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =    1540.4808 (64)
Heat gains from water heating, kWh/month
                64.9275    57.4728    60.9375    55.4287    54.8993    49.8893    48.7075    52.3525    51.9170    57.4370    59.7252    63.6360 (65)


-------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                13.5218    12.0099     9.7671     7.3943     5.5274     4.6664     5.0422     6.5541     8.7969    11.1697    13.0367    13.8976 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               151.3882   152.9591   149.0004   140.5728   129.9344   119.9359   113.2562   111.6853   115.6440   124.0716   134.7100   144.7085 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908 (71)
Water heating gains (Table 5)
                87.2681    85.5250    81.9053    76.9842    73.7893    69.2907    65.4670    70.3662    72.1069    77.2003    82.9516    85.5323 (72)
Total internal gains
               301.2371   299.5531   289.7318   274.0104   258.3102   242.9521   232.8246   237.6647   245.6069   261.5007   279.7573   293.1975 (73)


-------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------

[Jan]                                          Area      Solar flux              g              FF          Access             Gains
                                                 m2        Table 6a   Specific data   Specific data          factor                 W
                                                               W/m2     or Table 6b     or Table 6c        Table 6d
-------------------------------------------------------------------------------------------
Northeast                                    7.9800         11.2829          0.4000          0.7000          0.7700           17.4709 (75)
Northwest                                    3.0000         11.2829          0.4000          0.7000          0.7700            6.5680 (81)
-------------------------------------------------------------------------------------------

Solar gains     24.0390    48.9320    88.1600   144.7840   194.6181   207.4834   194.0965   154.7360   107.4243    59.7988    30.2473    19.6314 (83)
Total gains    325.2761   348.4851   377.8918   418.7944   452.9282   450.4355   426.9211   392.4007   353.0311   321.2995   310.0046   312.8289 (84)


-------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                             21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             64.4748    64.6326    64.7912    65.5959    65.7592    66.5883    66.5883    66.7566    66.2542    65.7592    65.4334    65.1107
alpha            5.2983     5.3088     5.3194     5.3731     5.3839     5.4392     5.4392     5.4504     5.4169     5.3839     5.3622     5.3407
util living area
                 0.9975     0.9959     0.9903     0.9666     0.8866     0.7138     0.5444     0.6096     0.8666     0.9790     0.9952     0.9980 (86)

MIT             19.8865    19.9932    20.2103    20.5259    20.8052    20.9575    20.9919    20.9857    20.8753    20.5331    20.1625    19.8682 (87)
Th 2            20.0196    20.0218    20.0239    20.0347    20.0369    20.0477    20.0477    20.0499    20.0434    20.0369    20.0326    20.0282 (88)
util rest of house
                 0.9966     0.9944     0.9867     0.9538     0.8446     0.6274     0.4319     0.4935     0.8021     0.9686     0.9933     0.9973 (89)
MIT 2           18.5351    18.6924    19.0096    19.4686    19.8423    20.0190    20.0447    20.0438    19.9394    19.4863    18.9479    18.5148 (90)
Living area fraction                                                                        fLA = Living area / (4) =    0.5814 (91)
MIT             19.3208    19.4486    19.7077    20.0833    20.4021    20.5646    20.5954    20.5914    20.4835    20.0949    19.6541    19.3016 (92)
Temperature adjustment                                                                                                    0.0000
adjusted MIT    19.3208    19.4486    19.7077    20.0833    20.4021    20.5646    20.5954    20.5914    20.4835    20.0949    19.6541    19.3016 (93)


-------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9959     0.9934     0.9853     0.9545     0.8620     0.6760     0.4976     0.5612     0.8346     0.9694     0.9923     0.9966 (94)
Useful gains   323.9266   346.1744   372.3297   399.7596   390.4421   304.5131   212.4148   220.2228   294.6411   311.4636   307.6116   311.7702 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               834.8142   806.5998   730.4611   610.9148   474.1942   320.9771   215.0042   224.9837   345.2502   517.3924   687.5005   831.1115 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               380.1004   309.4059   266.4498   152.0318    62.3116     0.0000     0.0000     0.0000     0.0000   153.2111   273.5200   386.3899 (98)
Space heating                                                                                                          1983.4204 (98)
Space heating per m2                                                                                     (98) / (4) =    38.4384 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                      0.0000 (301)
Fraction of space heat from community system                                               1.0000 (302)
Fraction of heat from community Boilers                                                    1.0000 (303a)
Fraction of total space heat from community Boilers                                        1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating           1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating           1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                          1.0500 (306)
Space heating:
Annual space heating requirement                                                        1983.4204 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     2082.5914 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)    0.0000 (308)
Space heating fuel for secondary/supplementary system                                      0.0000 (309)

Water heating
Annual water heating requirement                                                        1540.4808 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     1617.5048 (310a)
Electricity used for heat distribution                                                    37.0010 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                       82.6245 (330a)
Total electricity for the above, kWh/year                                                 82.6245 (331)
Electricity for lighting (calculated in Appendix L)                                      238.7986 (332)
Total delivered energy for all uses                                                     4021.5194 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                        Energy     Emission factor       Emissions
                                                      kWh/year          kg CO2/kWh     kg CO2/year
Efficiency of heat source Boilers                                                        89.5000 (367a)
Space heating from Boilers                           4134.1858              0.2160      892.9841 (367)
Electrical energy for heat distribution                37.0010              0.5190       19.2035 (372)
Total CO2 associated with community systems                                             912.1876 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                 912.1876 (376)
Pumps and fans                                         82.6245              0.5190       42.8821 (378)
Energy for lighting                                   238.7986              0.5190      123.9365 (379)
Total CO2, kg/year                                                                     1079.0062 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                              20.9100 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                      20.9100 ZC1
Total Floor Area                                                                   TFA   51.6000
Assumed number of occupants                                                          N    1.7373
CO2 emission factor in Table 12 for electricity displaced from grid                 EF    0.5190
CO2 emissions from appliances, equation (L14)                                            17.3856 ZC2
CO2 emissions from cooking, equation (L16)                                                3.1142 ZC3
Total CO2 emissions                                                                      41.4098 ZC4
Residual CO2 emissions offset from biofuel CHP                                            0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                  0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation           0.0000 ZC7
Net CO2 emissions                                                                        41.4098 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                      Area        Storey height          Volume
                                                                      (m2)                 (m)             (m3)
Ground floor                                                       51.6000 (1b)    x    2.5000 (2b)   =   129.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)      51.6000                                              (4)
Dwelling volume                                                         (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   129.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                              main         secondary          other            total       m3 per hour
                                           heating           heating
Number of chimneys                               0     +           0     +        0     =        0 * 40 =      0.0000 (6a)
Number of open flues                             0     +           0     +        0     =        0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                      2 * 10 =     20.0000 (7a)
Number of passive vents                                                                          0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                     0 * 40 =      0.0000 (7c)

                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans    = (6a)+(6b)+(7a)+(7b)+(7c) =               20.0000 / (5) =      0.1550 (8)
Pressure test                                                                                                     Yes
Measured/design AP50                                                                                           5.0000
Infiltration rate                                                                                              0.4050 (18)
Number of sides sheltered                                                                                           2 (19)

Shelter factor                                                             (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                             (21) = (18) x (20)    =      0.3443 (21)


                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.4390    0.4304    0.4217    0.3787    0.3701    0.3271    0.3271    0.3185    0.3443    0.3701    0.3873    0.4045 (22b)
Effective ac  0.5963    0.5926    0.5889    0.5717    0.5685    0.5535    0.5535    0.5507    0.5593    0.5685    0.5750    0.5818 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                    Gross      Openings       NetArea       U-value         A x U       K-value         A x K
                                              m2            m2            m2         W/m2K           W/K        kJ/m2K          kJ/K
TER Opaque door                                                       2.1200        1.0000        2.1200                              (26)
TER Opening Type (Uw = 1.40)                                         10.7900        1.3258       14.3049                              (27)
External Wall                            42.9000       10.7900       32.1100        0.1800        5.7798                              (29a)
Wall to CA                               20.1000        2.1200       17.9800        0.1800        3.2364                              (29a)
External Roof 1                          51.6000                     51.6000        0.1300        6.7080                              (30)
Total net area of external elements Aum(A, m2)                      114.6000                                                          (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =     32.1491                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                          250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                  15.3157 (36)
Total fabric heat loss                                                                                      (33) + (36) =   47.4648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m        25.3863   25.2271   25.0710   24.3377   24.2006   23.5619   23.5619   23.4437   23.8079   24.2006   24.4781   24.7682 (38)
Heat transfer coeff
             72.8512   72.6919   72.5358   71.8026   71.6654   71.0268   71.0268   70.9085   71.2728   71.6654   71.9429   72.2330 (39)
Average = Sum(39)m / 12 =                                                                                                  71.8019 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP           1.4118    1.4088    1.4057    1.3915    1.3889    1.3765    1.3765    1.3742    1.3813    1.3889    1.3942    1.3999 (40)
HLP (average)                                                                                                              1.3915 (40)
Days in month
                  31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                          1.7373 (42)
Average daily hot water use (litres/day)                                                                                  75.4602 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             83.0062   79.9878   76.9694   73.9510   70.9326   67.9141   67.9141   70.9326   73.9510   76.9694   79.9878   83.0062 (44)
Energy conte 123.0958 107.6603  111.0958   96.8560   92.9357   80.1964   74.3138   85.2761   86.2946  100.5680  109.7779  119.2117 (45)
Energy content (annual)                                                                            Total = Sum(45)m =   1187.2821 (45)
Distribution loss  (46)m = 0.15 x (45)m
             18.4644   16.1491   16.6644   14.5284   13.9404   12.0295   11.1471   12.7914   12.9442   15.0852   16.4667   17.8818 (46)
Water storage loss:
Store volume                                                                                                               3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                              0.2602 (48)
  Temperature factor from Table 2b                                                                                         0.5400 (49)
Enter (49) or (54) in (55)                                                                                                 0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Total storage loss
                  4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
                  4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss     23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
                150.7134   132.6053   138.7135   123.5828   120.5533   106.9232   101.9314   112.8938   113.0214   128.1857   136.5047   146.8293 (62)
Solar input       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =          0.0000 (63)
Output from w/h
                150.7134   132.6053   138.7135   123.5828   120.5533   106.9232   101.9314   112.8938   113.0214   128.1857   136.5047   146.8293 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =       1512.4580 (64)
Heat gains from water heating, kWh/month
                 63.0235    55.7531    59.0335    53.5861    52.9952    48.0467    46.8035    50.4485    50.0744    55.5330    57.8826    61.7320 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m            86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635    86.8635 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 13.5375    12.0239     9.7785     7.4029     5.5338     4.6719     5.0481     6.5617     8.8071    11.1827    13.0518    13.9138 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                151.3882   152.9591   149.0004   140.5728   129.9344   119.9359   113.2562   111.6853   115.6440   124.0716   134.7100   144.7085 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863    31.6863 (69)
Pumps, fans       3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
                -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908   -69.4908 (71)
Water heating gains (Table 5)
                 84.7090    82.9659    79.3461    74.4251    71.2302    66.7316    62.9079    67.8071    69.5478    74.6411    80.3925    82.9731 (72)
Total internal gains
                301.6937   300.0079   290.1841   274.4599   258.7575   243.3984   233.2713   238.1131   246.0579   261.9545   280.2133   293.6545 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                      Area          Solar flux              g               FF            Access              Gains
                                             m2            Table 6a   Specific data   Specific data            factor                  W
                                                               W/m2     or Table 6b     or Table 6c          Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                7.8400             11.2829          0.6300          0.7000            0.7700            27.0340 (75)
Northwest                                2.9500             11.2829          0.6300          0.7000            0.7700            10.1722 (81)
-----------------------------------------------------------------------------------------------------

Solar gains      37.2062    75.7343   136.4492   224.0888   301.2193   321.1317   300.4121   239.4920   166.2655    92.5534    46.8151    30.3845 (83)
Total gains     338.9000   375.7423   426.6333   498.5487   559.9768   564.5300   533.6834   477.6051   412.3234   354.5079   327.0284   324.0390 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                       21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau              49.1870    49.2948    49.4009    49.9054    50.0009    50.4505    50.4505    50.5346    50.2763    50.0009    49.8080    49.6080
alpha             4.2791     4.2863     4.2934     4.3270     4.3334     4.3634     4.3634     4.3690     4.3518     4.3334     4.3205     4.3072
util living area
                  0.9970     0.9948     0.9875     0.9594     0.8758     0.7165     0.5607     0.6360     0.8771     0.9786     0.9946     0.9975 (86)

MIT              19.4734    19.6155    19.9036    20.3192    20.6929    20.9125    20.9768    20.9608    20.7727    20.3051    19.8242    19.4502 (87)
Th 2             19.7543    19.7566    19.7589    19.7698    19.7719    19.7814    19.7814    19.7832    19.7777    19.7719    19.7678    19.7634 (88)
util rest of house
                  0.9959     0.9929     0.9828     0.9428     0.8255     0.6129     0.4176     0.4896     0.8054     0.9670     0.9923     0.9966 (89)
MIT 2            17.7484    17.9571    18.3772    18.9771    19.4749    19.7250    19.7735    19.7677    19.5921    18.9685    18.2700    17.7205 (90)
Living area fraction                                                                              fLA = Living area / (4) =        0.5814 (91)
MIT              18.7513    18.9212    19.2647    19.7574    20.1831    20.4154    20.4731    20.4613    20.2785    19.7456    19.1736    18.7261 (92)
Temperature adjustment                                                                                                             0.0000
adjusted MIT     18.7513    18.9212    19.2647    19.7574    20.1831    20.4154    20.4731    20.4613    20.2785    19.7456    19.1736    18.7261 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9947     0.9912     0.9803     0.9426     0.8443     0.6699     0.5012     0.5749     0.8389     0.9667     0.9908     0.9956 (94)
Useful gains    337.0971   372.4327   418.2326   469.9336   472.7832   378.1643   267.4775   274.5545   345.8856   342.7134   324.0161   322.6162 (95)
Ext temp.         4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
               1052.7940  1019.2308   925.8947   779.5880   607.9414   413.0491   275.0914   287.9831   440.3596   655.4243   868.6111  1049.2647 (97)
Month fracti      1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
                532.4785   434.6483   377.7006   222.9512   100.5577     0.0000     0.0000     0.0000     0.0000   232.6569   392.1084   540.6264 (98)
Space heating                                                                                                                   2833.7280 (98)
Space heating per m2                                                                                        (98) / (4) =       54.9172 (99)


-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                            0.0000 (201)
Fraction of space heat from main system(s)                                                                                       1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                          0.0000 (208)
Space heating requirement                                                                                                     3030.7252 (211)

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
                532.4785   434.6483   377.7006   222.9512   100.5577     0.0000     0.0000     0.0000     0.0000   232.6569   392.1084   540.6264 (98)
Space heating efficiency (main heating system 1)
                 93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
                569.4957   464.8645   403.9578   238.4505   107.5484     0.0000     0.0000     0.0000     0.0000   248.8309   419.3673   578.2101 (211)
Water heating requirement
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
                150.7134   132.6053   138.7135   123.5828   120.5533   106.9232   101.9314   112.8938   113.0214   128.1857   136.5047   146.8293 (64)
Efficiency of water heater                                                                                                      79.8000 (216)
(217)m           87.9000    87.7495    87.3538    86.3699    84.3347    79.8000    79.8000    79.8000    79.8000    86.3853    87.4713    87.9804 (217)
Fuel for water heating, kWh/month
                171.4602   151.1180   158.7950   143.0854   142.9464   133.9890   127.7336   141.4709   141.6308   148.3884   156.0565   166.8887 (219)
Water heating fuel used                                                                                                       1783.5630 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                              3030.7252 (211)
Space heating fuel - secondary                                                                                                   0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                         30.0000 (230c)
   main heating flue fan                                                                                                        45.0000 (230e)
Total electricity for the above, kWh/year                                                                                       75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                            239.0768 (232)
Total delivered energy for all uses                                                                                           5128.3649 (238)


-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                               Energy       Emission factor           Emissions
                                                                             kWh/year           kg CO2/kWh         kg CO2/year
Space heating - main system 1                                               3030.7252               0.2160            654.6366 (261)
Space heating - secondary                                                      0.0000               0.0000              0.0000 (263)
Water heating (other fuel)                                                  1783.5630               0.2160            385.2496 (264)
Space and water heating                                                                                              1039.8862 (265)
Pumps and fans                                                                75.0000               0.5190             38.9250 (267)
Energy for lighting                                                          239.0768               0.5190            124.0808 (268)
Total CO2, kg/m2/year                                                                                                1202.8921 (272)
Emissions per m2 for space and water heating                                                                           20.1528 (272a)
Fuel factor (mains gas)                                                                                                 1.0000
Emissions per m2 for lighting                                                                                           2.4047 (272b)
Emissions per m2 for pumps and fans                                                                                     0.7544 (272c)
Target Carbon Dioxide Emission Rate (TER) = (20.1528 * 1.00) + 2.4047 + 0.7544, rounded to 2 d.p.                      23.3100 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	010 Block B1-2B4P-03281	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Top floor
Property	010 Block B1-2B4P, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	17.50	**TER**	19.29
Environmental	87 B	**% DER<TER**	9.29		
CO_2 Emissions (t/year)	1.06	**DFEE**	51.63	**TFEE**	60.81
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.09		

Assessor Details	Mr. Marek Chmel, Marek Chmel, Tel: 07715818901, marek@hodkinsonconsultancy.com	**Assessor ID**	T305-0001
Client	St Edward Homes		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 78 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
--------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.29 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.50 kgCO□/m²OK
--------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.6 kWh/m²/yrOK
--------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.10 (max. 0.20)        0.10 (max. 0.35)          OK
Openings        1.33 (max. 2.00)        1.40 (max. 3.30)          OK
--------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
--------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                            OK
--------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                        -

Secondary heating system:               None
--------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
--------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


--------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                             OK
--------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                             OK
MVHR efficiency:                        91%
Minimum:                                70%                                             OK
--------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                          OK
Based on:
Overshading:                            Average
Windows facing North East:              8.10 m², No overhang
Windows facing South East:              8.10 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
--------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.10 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                      Area         Storey height           Volume
                                                                      (m2)              (m)                 (m3)
Ground floor                                                      77.6000 (1b)    x      2.5000 (2b)    =    194.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          77.6000                                               (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    194.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                    main          secondary           other              total        m3 per hour
                                                  heating          heating
Number of chimneys                                  0       +         0        +        0       =          0 * 40 =      0.0000 (6a)
Number of open flues                                0       +         0        +        0       =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                    0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                               0 * 40 =      0.0000 (7c)

                                                                                                       Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                         0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                           Yes
Measured/design AP50                                                                                                 3.0000
Infiltration rate                                                                                                    0.1500 (18)
Number of sides sheltered                                                                                                 2 (19)

Shelter factor                                                                          (20) = 1 - [0.075 x (19)] =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                            (21) = (18) x (20) =      0.1275 (21)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed     5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor    1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
               0.1626    0.1594    0.1562    0.1403    0.1371    0.1211    0.1211    0.1179    0.1275    0.1371    0.1434    0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                           0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                        77.3500 (23c)

Effective ac   0.2758    0.2726    0.2694    0.2535    0.2503    0.2344    0.2344    0.2312    0.2408    0.2503    0.2567    0.2631 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                        Gross      Openings      NetArea      U-value        A x U      K-value       A x K
                                                  m2            m2           m2        W/m2K          W/K       kJ/m2K        kJ/K
Window Double-Glazed (Uw = 1.40)                                        16.2000       1.3258      21.4773                          (27)
Door                                                                     2.1200       0.8200       1.7384                          (26)
External Wall                                53.4800       16.2000      37.2800       0.1800       6.7104                          (29a)
Wall to CA                                   29.6300        2.1200      27.5100       0.1671       4.5961                          (29a)
External Roof 1                              77.6000                    77.6000       0.1000       7.7600                          (30)
Total net area of external elements Aum(A, m2)                         160.7100                                                    (31)
Fabric heat loss, W/K = Sum (A x U)                                        (26)...(30) + (32) =   42.2821                          (33)
Party Wall 1                                                            25.9500       0.0000       0.0000                          (32)
Party Floor 1                                                           77.6000                                                    (32d)
Party Ceilings 1                                                        77.6000                                                    (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                   250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                           16.4741 (36)
Total fabric heat loss                                                                                (33) + (36) =   58.7562 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m         17.6575   17.4535   17.2494   16.2291   16.0250   15.0047   15.0047   14.8006   15.4128   16.0250   16.4331   16.8413 (38)
Heat transfer coeff
              76.4138   76.2097   76.0056   74.9853   74.7812   73.7609   73.7609   73.5569   74.1691   74.7812   75.1894   75.5975 (39)
Average = Sum(39)m / 12 =                                                                                            74.9343 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.9847    0.9821    0.9795    0.9663    0.9637    0.9505    0.9505    0.9479    0.9558    0.9637    0.9689    0.9742 (40)
HLP (average)                                                                                                          0.9656 (40)
Days in month
                   31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                      2.4157 (42)
Average daily hot water use (litres/day)                                                                              91.5740 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             100.7313   97.0684   93.4054   89.7425   86.0795   82.4166   82.4166   86.0795   89.7425   93.4054   97.0684  100.7313 (44)
Energy conte 149.3817  130.6502  134.8193  117.5387  112.7812   97.3216   90.1828  103.4860  104.7220  122.0434  133.2199  144.6682 (45)
Energy content (annual)                                                                           Total = Sum(45)m =   1440.8149 (45)
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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Distribution loss  (46)m = 0.15 x (45)m
              22.4073   19.5975   20.2229   17.6308   16.9172   14.5982   13.5274   15.5229   15.7083   18.3065   19.9830   21.7002 (46)
Water storage loss:
Store volume                                                                                                           3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                          0.0212 (51)
  Volume factor from Table 2a                                                                                          3.4200 (52)
  Temperature factor from Table 2b                                                                                     1.0000 (53)
Enter (49) or (54) in (55)                                                                                             0.2173 (55)
Total storage loss
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (57)
Primary loss  23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
             179.3794  157.7449  164.8170  146.5687  142.7789  126.3516  120.1805  133.4837  133.7520  152.0411  162.2499  174.6659 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                           Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
             179.3794  157.7449  164.8170  146.5687  142.7789  126.3516  120.1805  133.4837  133.7520  152.0411  162.2499  174.6659 (64)
                                                                            Total per year (kWh/year) = Sum(64)m =   1794.0135 (64)
Heat gains from water heating, kWh/month
              73.6676   65.1169   68.8256   62.3056   61.4979   55.5835   53.9839   58.4073   58.0441   64.5776   67.5196   72.1003 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873  120.7873 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.1702   17.0268   13.8471   10.4832    7.8363    6.6157    7.1485    9.2919   12.4716   15.8356   18.4824   19.7030 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             214.3515  216.5758  210.9707  199.0380  183.9750  169.8180  160.3603  158.1360  163.7411  175.6738  190.7368  204.8938 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787   35.0787 (69)
Pumps, fans    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298  -96.6298 (71)
Water heating gains (Table 5)
              99.0155   96.9002   92.5075   86.5356   82.6585   77.1992   72.5590   78.5044   80.6168   86.7978   93.7773   96.9090 (72)
Total internal gains
             391.7735  389.7390  376.5615  355.2929  333.7060  312.8692  299.3040  305.1685  316.0657  337.5434  362.2327  380.7420 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                         Area      Solar flux              g             FF          Access            Gains
                                                m2       Table 6a   Specific data  Specific data          factor                W
                                                            W/m2     or Table 6b    or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                   8.1000        11.2829         0.4000         0.7000          0.7700          17.7337 (75)
Southeast                                   8.1000        36.7938         0.4000         0.7000          0.7700          57.8297 (77)
-----------------------------------------------------------------------------------------------------

Solar gains   75.5634  134.6029  199.8155  273.8061  330.6227  338.7609  322.2199  278.2225  225.1851  152.9834   91.5803   63.9724 (83)
Total gains  467.3369  524.3419  576.3770  629.0991  664.3287  651.6301  621.5239  583.3910  541.2508  490.5268  453.8129  444.7144 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                           21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           70.5225   70.7113   70.9012   71.8659   72.0620   73.0589   73.0589   73.2615   72.6568   72.0620   71.6709   71.2840
alpha          5.7015    5.7141    5.7267    5.7911    5.8041    5.8706    5.8706    5.8841    5.8438    5.8041    5.7781    5.7523
util living area
               0.9979    0.9955    0.9882    0.9599    0.8718    0.6907    0.5166    0.5699    0.8289    0.9734    0.9954    0.9984 (86)

MIT           19.9896   20.1199   20.3349   20.6200   20.8543   20.9724   20.9957   20.9926   20.9208   20.6239   20.2573   19.9672 (87)
Th 2          20.0961   20.0983   20.1005   20.1115   20.1137   20.1248   20.1248   20.1270   20.1203   20.1137   20.1093   20.1049 (88)
util rest of house
               0.9973    0.9941    0.9841    0.9454    0.8289    0.6099    0.4168    0.4670    0.7609    0.9610    0.9936    0.9979 (89)
MIT 2         18.7419   18.9335   19.2471   19.6605   19.9696   20.1062   20.1231   20.1238   20.0566   19.6733   19.1428   18.7158 (90)
Living area fraction                                                                        fLA = Living area / (4) =   0.4253 (91)
MIT           19.2725   19.4380   19.7097   20.0685   20.3458   20.4745   20.4942   20.4933   20.4241   20.0775   19.6168   19.2480 (92)
Temperature adjustment                                                                                                 0.0000
adjusted MIT  19.2725   19.4380   19.7097   20.0685   20.3458   20.4745   20.4942   20.4933   20.4241   20.0775   19.6168   19.2480 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9964    0.9926    0.9818    0.9446    0.8412    0.6433    0.4595    0.5110    0.7864    0.9604    0.9923    0.9973 (94)
Useful gains 465.6552  520.4731  565.9001  594.2493  558.8408  419.2254  285.5649  298.0836  425.6637  471.0975  450.3150  443.4922 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1144.1020 1107.9365 1004.0080  837.4760  646.5464  433.3106  287.2366  301.0879  469.0538  708.7402  941.1297 1137.5883 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             504.7644  394.7754  325.9522  175.1232   65.2530    0.0000    0.0000    0.0000    0.0000  176.8062  353.3866  516.4075 (98)
Space heating                                                                                                       2512.4685 (98)
Space heating per m2                                                                                  (98) / (4) =   32.3772 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable


----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                  0.0000 (301)
Fraction of space heat from community system                                           1.0000 (302)
Fraction of heat from community Boilers                                                1.0000 (303a)
Fraction of total space heat from community Boilers                                    1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating       1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating       1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                      1.0500 (306)
Space heating:
Annual space heating requirement                                                    2512.4685 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                 2638.0919 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                  0.0000 (309)

Water heating
Annual water heating requirement                                                    1794.0135 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                 1883.7142 (310a)
Electricity used for heat distribution                                                45.2181 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
   mechanical ventilation fans (SFP =       0.5500)                                  130.1740 (330a)
Total electricity for the above, kWh/year                                            130.1740 (331)
Electricity for lighting (calculated in Appendix L)                                  338.5518 (332)
Total delivered energy for all uses                                                 4990.5319 (338)


----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                     Energy      Emission factor       Emissions
                                                   kWh/year          kg CO2/kWh     kg CO2/year
Efficiency of heat source Boilers                                                      89.5000 (367a)
Space heating from Boilers                        5052.2973               0.2160     1091.2962 (367)
Electrical energy for heat distribution             45.2181               0.5190       23.4682 (372)
Total CO2 associated with community systems                                          1114.7644 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                              1114.7644 (376)
Pumps and fans                                     130.1740               0.5190       67.5603 (378)
Energy for lighting                                338.5518               0.5190      175.7084 (379)
Total CO2, kg/year                                                                   1358.0331 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                            17.5000 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                   17.5000 ZC1
Total Floor Area                                                              TFA     77.6000
Assumed number of occupants                                                     N      2.4157
CO2 emission factor in Table 12 for electricity displaced from grid            EF      0.5190
CO2 emissions from appliances, equation (L14)                                         16.3686 ZC2
CO2 emissions from cooking, equation (L16)                                             2.2806 ZC3
Total CO2 emissions                                                                   36.1492 ZC4
Residual CO2 emissions offset from biofuel CHP                                         0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                               0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation        0.0000 ZC7
Net CO2 emissions                                                                     36.1492 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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----------------------------------------------------------------------------------------------------


----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                   Area        Storey height           Volume
                                                                   (m2)             (m)                 (m3)
Ground floor                                                  77.6000 (1b)   x    2.5000 (2b)   =   194.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)     77.6000                                           (4)
Dwelling volume                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   194.0000 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                             main          secondary          other          total      m3 per hour
                                          heating            heating
Number of chimneys                              0      +           0     +        0     =      0 * 40 =     0.0000 (6a)
Number of open flues                            0      +           0     +        0     =      0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                    3 * 10 =    30.0000 (7a)
Number of passive vents                                                                        0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                   0 * 40 =     0.0000 (7c)

                                                                                          Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =            30.0000 / (5) =     0.1546 (8)
Pressure test                                                                                                Yes
Measured/design AP50                                                                                      5.0000
Infiltration rate                                                                                         0.4046 (18)
Number of sides sheltered                                                                                      2 (19)

Shelter factor                                                        (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                        (21) = (18) x (20)   =      0.3439 (21)


                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed   5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor  1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
             0.4385   0.4299   0.4213   0.3783   0.3697   0.3267   0.3267   0.3181   0.3439   0.3697   0.3869   0.4041 (22b)
Effective ac 0.5962   0.5924   0.5888   0.5716   0.5684   0.5534   0.5534   0.5506   0.5591   0.5684   0.5749   0.5817 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                    Gross    Openings     NetArea    U-value      A x U     K-value      A x K
                                              m2          m2          m2     W/m2K        W/K      kJ/m2K       kJ/K
TER Opaque door                                                   2.1200     1.0000     2.1200                      (26)
TER Opening Type (Uw = 1.40)                                     16.2000     1.3258    21.4773                      (27)
External Wall                            53.4800     16.2000     37.2800     0.1800     6.7104                      (29a)
Wall to CA                               29.6300      2.1200     27.5100     0.1800     4.9518                      (29a)
External Roof 1                          77.6000                 77.6000     0.1300    10.0880                      (30)
Total net area of external elements Aum(A, m2)                  160.7100                                            (31)
Fabric heat loss, W/K = Sum (A x U)                            (26)...(30) + (32) =    45.3475                      (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                        250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                18.4278 (36)
Total fabric heat loss                                                                    (33) + (36) =    63.7753 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m       38.1657   37.9267   37.6924   36.5919   36.3860   35.4275   35.4275   35.2500   35.7967   36.3860   36.8025   37.2380 (38)
Heat transfer coeff
           101.9410  101.7020  101.4677  100.3672  100.1613   99.2028   99.2028   99.0253   99.5720  100.1613  100.5778  101.0133 (39)
Average = Sum(39)m / 12 =                                                                                           100.3662 (39)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP          1.3137    1.3106    1.3076    1.2934    1.2907    1.2784    1.2784    1.2761    1.2831    1.2907    1.2961    1.3017 (40)
HLP (average)                                                                                                         1.2934 (40)
Days in month
                 31        28        31        30        31        30        31        31        30        31        30        31 (41)


----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                     2.4157 (42)
Average daily hot water use (litres/day)                                                                             91.5740 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
           100.7313   97.0684   93.4054   89.7425   86.0795   82.4166   82.4166   86.0795   89.7425   93.4054   97.0684  100.7313 (44)
Energy conte 149.3817 130.6502 134.8193 117.5387 112.7812  97.3216   90.1828  103.4860  104.7220  122.0434  133.2199  144.6682 (45)
Energy content (annual)                                                                    Total = Sum(45)m =  1440.8149 (45)
Distribution loss  (46)m = 0.15 x (45)m
            22.4073   19.5975   20.2229   17.6308   16.9172   14.5982   13.5274   15.5229   15.7083   18.3065   19.9830   21.7002 (46)
Water storage loss:
Store volume                                                                                                          3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                         0.2602 (48)
  Temperature factor from Table 2b                                                                                    0.5400 (49)
Enter (49) or (54) in (55)                                                                                            0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(64)
Total per year (kWh/year) = Sum(64)m =												1765.9907	(64)
Heat gains from water heating, kWh/month	71.7635	63.3972	66.9215	60.4630	59.5939	53.7409	52.0799	56.5032	56.2015	62.6736	65.6770	70.1963	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.1702	17.0268	13.8471	10.4832	7.8363	6.6157	7.1485	9.2919	12.4716	15.8356	18.4824	19.7030	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	214.3515	216.5758	210.9707	199.0380	183.9750	169.8180	160.3603	158.1360	163.7411	175.6738	190.7368	204.8938	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	(71)
Water heating gains (Table 5)	96.4564	94.3410	89.9483	83.9765	80.0993	74.6401	69.9999	75.9452	78.0576	84.2387	91.2181	94.3499	(72)
Total internal gains	392.2143	390.1799	377.0023	355.7338	334.1468	313.3100	299.7448	305.6093	316.5065	337.9842	362.6735	381.1828	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.1000	11.2829	0.6300	0.7000	0.7700	27.9305	(75)
Southeast	8.1000	36.7938	0.6300	0.7000	0.7700	91.0819	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	119.0124	211.9995	314.7094	431.2447	520.7308	533.5484	507.4964	438.2005	354.6665	240.9489	144.2389	100.7566	(83)
Total gains	511.2267	602.1794	691.7117	786.9784	854.8776	846.8584	807.2412	743.8098	671.1730	578.9331	506.9124	481.9394	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.8628	52.9871	53.1094	53.6918	53.8021	54.3220	54.3220	54.4193	54.1205	53.8021	53.5793	53.3483	
alpha	4.5242	4.5325	4.5406	4.5795	4.5868	4.6215	4.6215	4.6280	4.6080	4.5868	4.5720	4.5566	
util living area	0.9970	0.9932	0.9825	0.9470	0.8543	0.6879	0.5258	0.5862	0.8312	0.9688	0.9938	0.9977	(86)
MIT	19.5983	19.7779	20.0686	20.4466	20.7627	20.9381	20.9857	20.9769	20.8473	20.4326	19.9458	19.5677	(87)
Th 2	19.8301	19.8325	19.8349	19.8460	19.8481	19.8578	19.8578	19.8596	19.8541	19.8481	19.8439	19.8395	(88)
util rest of house	0.9959	0.9908	0.9762	0.9271	0.8015	0.5890	0.3968	0.4536	0.7512	0.9532	0.9913	0.9969	(89)
MIT 2	17.9814	18.2446	18.6669	19.2086	19.6217	19.8183	19.8529	19.8506	19.7351	19.2009	18.4983	17.9432	(90)
Living area fraction — fLA = Living area / (4) =												0.4253	(91)
MIT	18.6690	18.8967	19.2630	19.7351	20.1069	20.2945	20.3346	20.3296	20.2081	19.7247	19.1139	18.6340	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6690	18.8967	19.2630	19.7351	20.1069	20.2945	20.3346	20.3296	20.2081	19.7247	19.1139	18.6340	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9882	0.9721	0.9248	0.8147	0.6290	0.4521	0.5104	0.7790	0.9510	0.9890	0.9957	(94)
Useful gains	508.3744	595.0810	672.4280	727.7891	696.5060	532.6387	364.9352	379.6287	522.8245	550.5850	501.3227	479.8550	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1464.7917	1423.4883	1295.0326	1087.4849	842.0470	564.9085	370.4861	389.1303	608.1933	913.9423	1208.3294	1458.0256	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	711.5745	556.6897	463.2179	258.9810	108.2825	0.0000	0.0000	0.0000	0.0000	270.3378	509.0449	727.7589	(98)
Space heating												3605.8870	(98)
Space heating per m2 — (98) / (4) =												46.4676	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3856.5637	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	711.5745	556.6897	463.2179	258.9810	108.2825	0.0000	0.0000	0.0000	0.0000	270.3378	509.0449	727.7589	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	761.0422	595.3900	495.4202	276.9850	115.8102	0.0000	0.0000	0.0000	0.0000	289.1314	544.4330	778.3517	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1457	87.9247	87.4555	86.3574	84.1312	79.8000	79.8000	79.8000	79.8000	86.3731	87.6889	88.2353	(217)
Fuel for water heating, kWh/month	200.8031	176.9642	185.7367	167.0563	166.8809	155.4491	147.6196	164.2904	164.7228	173.2727	182.4025	195.2573	(219)
Water heating fuel used												2080.4555	(219)

Annual totals kWh/year		
Space heating fuel - main system	3856.5637	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	338.5518	(232)
Total delivered energy for all uses	6350.5710	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3856.5637	0.2160	833.0178	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2080.4555	0.2160	449.3784	(264)
Space and water heating			1282.3961	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	338.5518	0.5190	175.7084	(268)
Total CO2, kg/m2/year			1497.0295	(272)
Emissions per m2 for space and water heating			16.5257	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2643	(272b)
Emissions per m2 for pumps and fans			0.5016	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5257 * 1.00) + 2.2643 + 0.5016, rounded to 2 d.p.			19.2900	(273)

Appendix B

Full SAP 2012 – Be Green

Property Reference	03 - 001 A2 - 1B2P	**Issued on Date**	15/12/2020
Assessment Reference	1B2P Be Clean	**Prop Type Ref**	Exposed Floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	83 B	**DER**	14.17	**TER**	28.60
Environmental	91 B	**% DER<TER**	50.46		
CO_2 Emissions (t/year)	0.61	**DFEE**	42.82	**TFEE**	52.53
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.48		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 28.60 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.17 kgCO□/m²OK
-------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.8 kWh/m²/yrOK
-------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.10 (max. 0.25)        0.10 (max. 0.70)          OK
Roof             (no roof)
Openings        1.26 (max. 2.00)        1.40 (max. 3.30)          OK
-------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                        OK
-------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                    -

Secondary heating system:               None
-------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
-------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


-------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                         OK
-------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.42
Maximum                                 1.5                                         OK
MVHR efficiency:                        91%
Minimum:                                70%                                         OK
-------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                      OK
Based on:
Overshading:                            Average
Windows facing North:                   6.98 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
-------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Exposed floor U-value                   0.10 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.14 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------------
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-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                      Area         Storey height                 Volume
                                                                      (m2)                  (m)                   (m3)
Ground floor                                                       55.6000 (1b)     x      2.5000 (2b)     =    139.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          55.6000                                                  (4)
Dwelling volume                                                         (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    139.0000 (5)


-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                              main          secondary           other              total        m3 per hour
                                           heating            heating
Number of chimneys                               0      +           0      +        0      =          0 * 40 =      0.0000 (6a)
Number of open flues                             0      +           0      +        0      =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                           0 * 10 =      0.0000 (7a)
Number of passive vents                                                                               0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                          0 * 40 =      0.0000 (7c)

                                                                                                 Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                     0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                3.0000
Infiltration rate                                                                                                   0.1500 (18)
Number of sides sheltered                                                                                                3 (19)

Shelter factor                                                                    (20) =  1  -  [0.075 x (19)]  =    0.7750 (20)
Infiltration rate adjusted to include shelter factor                                        (21) = (18) x (20)  =    0.1163 (21)


                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                          0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                       77.3500 (23c)

Effective ac    0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)



-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                     Gross       Openings        NetArea       U-value          A x U       K-value         A x K
                                               m2             m2             m2         W/m2K            W/K        kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                         6.9800        1.3258         9.2538                              (27)
Door                                                                     2.1200        0.8200         1.7384                              (26)
Exposed                                                                 55.6000        0.1000         5.5600                              (28b)
External Wall                             17.5000         6.9800        10.5200        0.1800         1.8936                              (29a)
Wall to Stairwell                         17.5000         2.1200        15.3800        0.1671         2.5695                              (29a)
Total net area of external elements Aum(A, m2)                          90.6000                                                           (31)
Fabric heat loss, W/K = Sum (A x U)                                        (26)...(30) + (32) =      21.0153                              (33)
Party Wall 1                                                            39.7500        0.0000         0.0000                              (32)
Party Ceilings 1                                                        55.6000                                                           (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                          9.2246 (36)
Total fabric heat loss                                                                         (33) + (36) =       30.2399 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          11.9936    11.8603    11.7270    11.0604    10.9271    10.2605    10.2605    10.1272    10.5272    10.9271    11.1937    11.4603 (38)
Heat transfer coeff
               42.2335    42.1002    41.9669    41.3003    41.1670    40.5005    40.5005    40.3671    40.7671    41.1670    41.4336    41.7002 (39)
Average = Sum(39)m / 12 =                                                                                                     41.2670 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.7596     0.7572     0.7548     0.7428     0.7404     0.7284     0.7284     0.7260     0.7332     0.7404     0.7452     0.7500 (40)
HLP (average)                                                                                                                  0.7422 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)



-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                   1.8549 (42)
Average daily hot water use (litres/day)                                                                           78.2543 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               86.0797    82.9495    79.8194    76.6892    73.5590    70.4289    70.4289    73.5590    76.6892    79.8194    82.9495    86.0797 (44)
Energy conte  127.6537   111.6468   115.2095   100.4424    96.3769    83.1659    77.0654    88.4337    89.4899   104.2919   113.8427   123.6258 (45)
Energy content (annual)                                                                              Total = Sum(45)m =  1231.2445 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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               19.1481    16.7470    17.2814    15.0664    14.4565    12.4749    11.5598    13.2651    13.4235    15.6438    17.0764    18.5439 (46)
Water storage loss:
Store volume                                                                                                        3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                        0.0212 (51)
  Volume factor from Table 2a                                                                                       3.4200 (52)
  Temperature factor from Table 2b                                                                                  1.0000 (53)
Enter (49) or (54) in (55)                                                                                          0.2173 (55)
Total storage loss
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              157.6514   138.7415   145.2071   129.4724   126.3746   112.1959   107.0631   118.4314   118.5199   134.2895   142.8727   153.6235 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
              157.6514   138.7415   145.2071   129.4724   126.3746   112.1959   107.0631   118.4314   118.5199   134.2895   142.8727   153.6235 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =   1584.4432 (64)
Heat gains from water heating, kWh/month
               66.4430    58.7983    62.3053    56.6211    56.0435    50.8767    49.6224    53.4024    52.9794    58.6752    61.0767    65.1037 (65)



-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459    92.7459 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               15.8446    14.0730    11.4449     8.6645     6.4768     5.4680     5.9084     7.6800    10.3080    13.0884    15.2761    16.2849 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              161.7305   163.4087   159.1796   150.1762   138.8111   128.1295   120.9935   119.3152   123.5444   132.5478   143.9129   154.5945 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746    32.2746 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967   -74.1967 (71)
Water heating gains (Table 5)
               89.3051    87.4975    83.7437    78.6404    75.3272    70.6621    66.6968    71.7774    73.5825    78.8645    84.8288    87.5050 (72)
Total internal gains
              317.7039   315.8030   305.1920   288.3050   271.4389   255.0833   244.4224   249.5963   258.2587   275.3244   294.8415   309.2082 (73)



-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------

[Jan]                                        Area      Solar flux              g               FF          Access           Gains
                                               m2        Table 6a   Specific data   Specific data          factor               W
                                                             W/m2     or Table 6b     or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------
North                                      6.9800         10.6334          0.4000          0.7000          0.7700         14.4019 (74)
-------------------------------------------------------------------------------------------------

Solar gains    14.4019    27.5227    46.7678    75.1210   101.1949   108.3322   101.1419    80.2432    56.2300    32.7622    17.7665    12.0061 (83)
Total gains   332.1058   343.3257   351.9597   363.4260   372.6339   363.4155   345.5644   329.8395   314.4887   308.0866   312.6081   321.2143 (84)



-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                       21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            91.4230    91.7125    92.0038    93.4887    93.7914    95.3350    95.3350    95.6498    94.7115    93.7914    93.1879    92.5921
alpha           7.0949     7.1142     7.1336     7.2326     7.2528     7.3557     7.3557     7.3767     7.3141     7.2528     7.2125     7.1728
util living area
                0.9975     0.9961     0.9914     0.9706     0.8904     0.6951     0.5138     0.5594     0.8254     0.9724     0.9944     0.9980 (86)

MIT            20.3198    20.3890    20.5275    20.7318    20.9068    20.9880    20.9988    20.9978    20.9603    20.7653    20.5166    20.3077 (87)
Th 2           20.2885    20.2906    20.2927    20.3032    20.3053    20.3158    20.3158    20.3179    20.3116    20.3053    20.3011    20.2969 (88)
util rest of house
                0.9967     0.9948     0.9885     0.9603     0.8555     0.6284     0.4350     0.4784     0.7667     0.9606     0.9923     0.9974 (89)
MIT 2          19.3716    19.4742    19.6771    19.9772    20.2104    20.3074    20.3153    20.3169    20.2792    20.0284    19.6687    19.3606 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.5737 (91)
MIT            19.9157    19.9991    20.1650    20.4102    20.6100    20.6979    20.7074    20.7076    20.6699    20.4512    20.1552    19.9040 (92)
Temperature adjustment                                                                                                       0.0000
adjusted MIT   19.9157    19.9991    20.1650    20.4102    20.6100    20.6979    20.7074    20.7076    20.6699    20.4512    20.1552    19.9040 (93)



-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9962     0.9942     0.9879     0.9621     0.8718     0.6663     0.4802     0.5250     0.7987     0.9635     0.9918     0.9969 (94)
Useful gains  330.8324   341.3392   347.7021   349.6423   324.8536   242.1595   165.9537   173.1507   251.1759   296.8363   310.0514   320.2228 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              659.5035   635.6727   573.4779   475.3742   366.7961   246.9670   166.3531   173.8852   267.8376   405.5445   540.9239   654.8598 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              244.5313   197.7921   167.9771    90.5269    31.2052     0.0000     0.0000     0.0000     0.0000    80.8790   166.2282   248.9699 (98)
Space heating                                                                                                               1228.1098 (98)
Space heating per m2                                                                               (98) / (4) =      22.0883 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                  0.0000 (301)
Fraction of space heat from community system                                                           1.0000 (302)
Fraction of heat from community Heat pump                                                              1.0000 (303b)
Fraction of total space heat from community Heat pump                                                  1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating                       1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                       1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                      1.3000 (306)
Space heating:
Annual space heating requirement                                                                    1228.1098 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                               1596.5428 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                0.0000 (308)
Space heating fuel for secondary/supplementary system                                                  0.0000 (309)

Water heating
Annual water heating requirement                                                                    1584.4432 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                               2059.7762 (310b)
Electricity used for heat distribution                                                                36.5632 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                                   89.0295 (330a)
Total electricity for the above, kWh/year                                                             89.0295 (331)
Electricity for lighting (calculated in Appendix L)                                                  279.8198 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =                                                              -106.4690 (333)
Total delivered energy for all uses                                                                 3918.6992 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                 Energy      Emission factor        Emissions
                                                               kWh/year          kg CO2/kWh      kg CO2/year
Efficiency of heat source Heat pump                                                                 300.0000 (367b)
Space heating from Heat pump                                  1218.7730              0.5190          632.5432 (368)
Electrical energy for heat distribution                         36.5632              0.5190           18.9763 (372)
Total CO2 associated with community systems                                                          651.5195 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                              651.5195 (376)
Pumps and fans                                                  89.0295              0.5190           46.2063 (378)
Energy for lighting                                            279.8198              0.5190          145.2265 (379)

 Energy saving/generation technologies
PV Unit                                                       -106.4690              0.5190          -55.2574 (380)
Total CO2, kg/year                                                                                   787.6948 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                           14.1700 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                   14.1700 ZC1
Total Floor Area                                                                               TFA    55.6000
Assumed number of occupants                                                                      N     1.8549
CO2 emission factor in Table 12 for electricity displaced from grid                             EF     0.5190
CO2 emissions from appliances, equation (L14)                                                         17.2371 ZC2
CO2 emissions from cooking, equation (L16)                                                             2.9410 ZC3
Total CO2 emissions                                                                                   34.3480 ZC4
Residual CO2 emissions offset from biofuel CHP                                                         0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                               0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                        0.0000 ZC7
Net CO2 emissions                                                                                     34.3480 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                   Area        Storey height          Volume
                                                                   (m2)                  (m)            (m3)
Ground floor                                                    55.6000 (1b)     x    2.5000 (2b)   =   139.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)           55.6000                                        (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   139.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                main         secondary            other            total       m3 per hour
                                             heating           heating
Number of chimneys                                 0     +           0     +          0     =        0 * 40 =      0.0000 (6a)
Number of open flues                               0     +           0     +          0     =        0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                          2 * 10 =     20.0000 (7a)
Number of passive vents                                                                              0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                         0 * 40 =      0.0000 (7c)

                                                                                             Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                20.0000 / (5) =      0.1439 (8)
Pressure test                                                                                                     Yes
Measured/design AP50                                                                                           5.0000
Infiltration rate                                                                                              0.3939 (18)
Number of sides sheltered                                                                                           3 (19)

Shelter factor                                                               (20) = 1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                (21) = (18) x (20)  =     0.3053 (21)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.3892    0.3816    0.3739    0.3358    0.3282    0.2900    0.2900    0.2824    0.3053    0.3282    0.3434    0.3587 (22b)
Effective ac  0.5757    0.5728    0.5699    0.5564    0.5538    0.5420    0.5420    0.5399    0.5466    0.5538    0.5590    0.5643 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                   Gross      Openings       NetArea       U-value         A x U       K-value         A x K
                                             m2            m2            m2        W/m2K           W/K        kJ/m2K          kJ/K
TER Opaque door                                                      2.1200        1.0000        2.1200                              (26)
TER Opening Type (Uw = 1.40)                                         6.9800        1.3258        9.2538                              (27)
Exposed                                                             55.6000        0.1300        7.2280                              (28b)
External Wall                           17.5000        6.9800       10.5200        0.1800        1.8936                              (29a)
Wall to Stairwell                       17.5000        2.1200       15.3800        0.1800        2.7684                              (29a)
Total net area of external elements Aum(A, m2)                      90.6000                                                          (31)
Fabric heat loss, W/K = Sum (A x U)                                      (26)...(30) + (32) =   23.2638                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                      250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                               9.6435 (36)
Total fabric heat loss                                                                                (33) + (36) =     32.9073 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m        26.4093   26.2743   26.1421   25.5210   25.4048   24.8638   24.8638   24.7636   25.0722   25.4048   25.6399   25.8856 (38)
Heat transfer coeff
             59.3165   59.1816   59.0494   58.4283   58.3121   57.7711   57.7711   57.6709   57.9795   58.3121   58.5472   58.7929 (39)
Average = Sum(39)m / 12 =                                                                                                 58.4277 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP           1.0668    1.0644    1.0620    1.0509    1.0488    1.0390    1.0390    1.0372    1.0428    1.0488    1.0530    1.0574 (40)
HLP (average)                                                                                                             1.0509 (40)
Days in month
                  31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                         1.8549 (42)
Average daily hot water use (litres/day)                                                                                 78.2543 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             86.0797   82.9495   79.8194   76.6892   73.5590   70.4289   70.4289   73.5590   76.6892   79.8194   82.9495   86.0797 (44)
Energy conte 127.6537  111.6468  115.2095  100.4424   96.3769   83.1659   77.0654   88.4337   89.4899  104.2919  113.8427  123.6258 (45)
Energy content (annual)                                                                          Total = Sum(45)m =    1231.2445 (45)
Distribution loss  (46)m = 0.15 x (45)m
             19.1481   16.7470   17.2814   15.0664   14.4565   12.4749   11.5598   13.2651   13.4235   15.6438   17.0764   18.5439 (46)
Water storage loss:
Store volume                                                                                                              3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                             0.2602 (48)
  Temperature factor from Table 2b                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
                4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
                4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss   23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
              155.2714  136.5918  142.8271  127.1692  123.9945  109.8927  104.6831  116.0514  116.2167  131.9095  140.5695  151.2435 (62)
Solar input     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                              Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
              155.2714  136.5918  142.8271  127.1692  123.9945  109.8927  104.6831  116.0514  116.2167  131.9095  140.5695  151.2435 (64)
                                                                               Total per year (kWh/year) = Sum(64)m =    1556.4204 (64)
Heat gains from water heating, kWh/month
               64.5390   57.0785   60.4013   54.7785   54.1394   49.0341   47.7184   51.4984   51.1368   56.7712   59.2341   63.1997 (65)
```

```
-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m          92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459   92.7459 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               15.8446   14.0730   11.4449    8.6645    6.4768    5.4680    5.9084    7.6800   10.3080   13.0884   15.2761   16.2849 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              161.7305  163.4087  159.1796  150.1762  138.8111  128.1295  120.9935  119.3152  123.5444  132.5478  143.9129  154.5945 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746   32.2746 (69)
Pumps, fans     3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967  -74.1967 (71)
Water heating gains (Table 5)
               86.7460   84.9383   81.1845   76.0813   72.7681   68.1029   64.1376   69.2182   71.0234   76.3053   82.2696   84.9459 (72)
Total internal gains
              318.1448  316.2438  305.6328  288.7458  271.8798  255.5242  244.8633  250.0372  258.6995  275.7653  295.2824  309.6491 (73)
```

```
-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------
[Jan]                               Area      Solar flux            g              FF         Access          Gains
                                      m2        Table 6a    Specific data   Specific data      factor              W
                                                    W/m2      or Table 6b     or Table 6c    Table 6d
-----------------------------------------------------------------------------------------------------
North                             6.9800         10.6334        0.6300          0.7000        0.7700        22.6829 (74)
-----------------------------------------------------------------------------------------------------

Solar gains    22.6829   43.3482   73.6592  118.3156  159.3820  170.6231  159.2985  126.3830   88.5623   51.6004   27.9823   18.9096 (83)
Total gains   340.8277  359.5920  379.2920  407.0614  431.2618  426.1473  404.1618  376.4202  347.2618  327.3657  323.2647  328.5587 (84)
```

```
-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                             21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau            65.0933   65.2417   65.3878   66.0829   66.2146   66.8347   66.8347   66.9508   66.5945   66.2146   65.9487   65.6731
alpha           5.3396    5.3494    5.3592    5.4055    5.4143    5.4556    5.4556    5.4634    5.4396    5.4143    5.3966    5.3782
util living area
                0.9978    0.9966    0.9929    0.9779    0.9231    0.7794    0.6094    0.6704    0.8978    0.9833    0.9959    0.9982 (86)

MIT            19.8843   19.9800   20.1766   20.4686   20.7518   20.9352   20.9864   20.9777   20.8479   20.5104   20.1542   19.8665 (87)
Th 2           20.0280   20.0300   20.0320   20.0412   20.0429   20.0509   20.0509   20.0524   20.0478   20.0429   20.0394   20.0358 (88)
util rest of house
                0.9971    0.9954    0.9902    0.9688    0.8902    0.6958    0.4879    0.5490    0.8418    0.9748    0.9942    0.9976 (89)
MIT 2          18.5381   18.6793   18.9672   19.3947   19.7843   20.0045   20.0455   20.0423   19.9152   19.4594   18.9409   18.5177 (90)
Living area fraction                                                                     fLA = Living area / (4) =       0.5737 (91)
MIT            19.3105   19.4255   19.6611   20.0108   20.3394   20.5385   20.5853   20.5790   20.4504   20.0624   19.6370   19.2915 (92)
Temperature adjustment                                                                                                    0.0000
adjusted MIT   19.3105   19.4255   19.6611   20.0108   20.3394   20.5385   20.5853   20.5790   20.4504   20.0624   19.6370   19.2915 (93)
```

```
-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9963    0.9945    0.9889    0.9685    0.9017    0.7412    0.5580    0.6189    0.8683    0.9750    0.9933    0.9970 (94)
Useful gains  339.5769  357.6086  375.0926  394.2385  388.8534  315.8762  225.5105  232.9696  301.5354  319.1946  321.0881  327.5676 (95)
Ext temp.       4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
              890.3692  859.6451  777.1566  649.1876  503.7821  343.0724  230.2349  241.0069  368.1901  551.7701  734.0067  887.2764 (97)
Month fracti    1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
              409.7895  337.3685  299.1356  183.5633   85.5070    0.0000    0.0000    0.0000    0.0000  173.0362  297.3014  416.4234 (98)
Space heating                                                                                                          2202.1248 (98)
Space heating per m2                                                                              (98) / (4) =         39.6066 (99)
```

```
-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                    0.0000 (201)
Fraction of space heat from main system(s)                                                                               1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                        93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                  0.0000 (208)
Space heating requirement                                                                                             2355.2136 (211)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
              409.7895  337.3685  299.1356  183.5633   85.5070    0.0000    0.0000    0.0000    0.0000  173.0362  297.3014  416.4234 (98)
Space heating efficiency (main heating system 1)
               93.5000   93.5000   93.5000   93.5000   93.5000    0.0000    0.0000    0.0000    0.0000   93.5000   93.5000   93.5000 (210)
Space heating fuel (main heating system)
              438.2775  360.8219  319.9311  196.3244   91.4513    0.0000    0.0000    0.0000    0.0000  185.0654  317.9694  445.3726 (211)
Water heating requirement
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
              155.2714  136.5918  142.8271  127.1692  123.9945  109.8927  104.6831  116.0514  116.2167  131.9095  140.5695  151.2435 (64)
Efficiency of water heater                                                                                              79.8000 (216)
(217)m         87.2840   87.1330   86.7413   85.7921   83.8461   79.8000   79.8000   79.8000   79.8000   85.5387   86.7652   87.3785 (217)
Fuel for water heating, kWh/month
              177.8921  156.7624  164.6586  148.2294  147.8836  137.7101  131.1818  145.4278  145.6349  154.2104  162.0114  173.0901 (219)
Water heating fuel used                                                                                               1844.6928 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                      2355.2136 (211)
Space heating fuel - secondary                                                                                           0.0000 (215)

Electricity for pumps and fans:
  central heating pump                                                                                                  30.0000 (230c)
  main heating flue fan                                                                                                 45.0000 (230e)
Total electricity for the above, kWh/year                                                                               75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                    279.8198 (232)
Total delivered energy for all uses                                                                                   4554.7262 (238)
```

```
-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                        Energy      Emission factor         Emissions
                                                                      kWh/year          kg CO2/kWh       kg CO2/year
Space heating - main system 1                                        2355.2136              0.2160          508.7261 (261)
Space heating - secondary                                               0.0000              0.0000            0.0000 (263)
Water heating (other fuel)                                           1844.6928              0.2160          398.4536 (264)
Space and water heating                                                                                     907.1798 (265)
Pumps and fans                                                         75.0000              0.5190           38.9250 (267)
Energy for lighting                                                   279.8198              0.5190          145.2265 (268)
Total CO2, kg/m2/year                                                                                      1091.3312 (272)
Emissions per m2 for space and water heating                                                                 16.3162 (272a)
Fuel factor (electricity)                                                                                     1.5500
Emissions per m2 for lighting                                                                                 2.6120 (272b)
Emissions per m2 for pumps and fans                                                                           0.7001 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3162 * 1.55) + 2.6120 + 0.7001, rounded to 2 d.p.            28.6000 (273)
```

Property Reference	03 - 002 D2 - 3B5P	Issued on Date	15/12/2020
Assessment Reference	3B5P Be Clean	Prop Type Ref	Exposed Floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	DER	13.20	TER	23.00
Environmental	90 B	% DER<TER	42.60		
CO_2 Emissions (t/year)	0.90	DFEE	41.14	TFEE	45.14
General Requirements Compliance	Pass	% DFEE<TFEE	8.85		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	Assessor ID	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 87 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.00 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.20 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)41.1 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element          Average                Highest
External wall    0.17 (max. 0.30)       0.18 (max. 0.70)        OK
Party wall       0.00 (max. 0.20)        -                      OK
Floor            0.10 (max. 0.25)       0.10 (max. 0.70)        OK
Roof              (no roof)
Openings         1.33 (max. 2.00)       1.40 (max. 3.30)        OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                        OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                    -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                         OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                         OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                         OK
MVHR efficiency:                        91%
Minimum:                                70%                                         OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                      OK
Based on:
Overshading:                            Average
Windows facing South East:              16.35 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Exposed floor U-value                   0.10 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------


-------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------
                                                                  Area         Storey height           Volume
                                                                  (m2)               (m)                (m3)
Ground floor                                                   86.6000 (1b)    x      2.5000 (2b)    =    216.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            86.6000                                              (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    216.5000 (5)


-------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------
                                               main          secondary          other            total       m3 per hour
                                             heating          heating
Number of chimneys                               0      +         0      +         0      =          0 * 40 =      0.0000 (6a)
Number of open flues                             0      +         0      +         0      =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                          0 * 10 =      0.0000 (7a)
Number of passive vents                                                                              0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                         0 * 40 =      0.0000 (7c)

                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                      0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                        Yes
Measured/design AP50                                                                                              3.0000
Infiltration rate                                                                                                 0.1500 (18)
Number of sides sheltered                                                                                              3 (19)

Shelter factor                                                                    (20) =  1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                      (21) = (18) x (20)   =      0.1163 (21)


                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed     5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor    1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
               0.1482    0.1453    0.1424    0.1279    0.1250    0.1104    0.1104    0.1075    0.1163    0.1250    0.1308    0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                        0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                     77.3500 (23c)

Effective ac   0.2615    0.2586    0.2557    0.2411    0.2382    0.2237    0.2237    0.2208    0.2295    0.2382    0.2440    0.2498 (25)


-------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------
Element                                      Gross       Openings       NetArea       U-value        A x U        K-value         A x K
                                               m2             m2            m2         W/m2K          W/K         kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                         16.3500        1.3258      21.6761                            (27)
Door                                                                      2.1200        0.8200       1.7384                            (26)
Exposed                                                                  86.6000        0.1000       8.6600                            (28b)
External Wall                              33.9000        16.3500        17.5500        0.1800       3.1590                            (29a)
Wall to Stairwell                          29.8500         2.1200        27.7300        0.1671       4.6328                            (29a)
Total net area of external elements Aum(A, m2)                          150.3500                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                          (26)...(30) + (32) =   39.8664                            (33)
Party Wall 1                                                             36.0000        0.0000       0.0000                            (32)
Party Ceilings 1                                                         86.6000                                                   (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                               250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                       13.2458 (36)
Total fabric heat loss                                                                          (33) + (36) =    53.1122 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m         18.6806   18.4730   18.2654   17.2272   17.0195   15.9814   15.9814   15.7737   16.3966   17.0195   17.4348   17.8501 (38)
Heat transfer coeff
              71.7928   71.5852   71.3775   70.3393   70.1317   69.0935   69.0935   68.8859   69.5088   70.1317   70.5470   70.9622 (39)
Average = Sum(39)m / 12 =                                                                                        70.2874 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.8290    0.8266    0.8242    0.8122    0.8098    0.7978    0.7978    0.7954    0.8026    0.8098    0.8146    0.8194 (40)
HLP (average)                                                                                                     0.8116 (40)
Days in month
                   31        28        31        30        31        30        31        31        30        31        30        31 (41)


-------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                 2.5763 (42)
Average daily hot water use (litres/day)                                                                         95.3863 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             104.9249  101.1095   97.2940   93.4786   89.6631   85.8477   85.8477   89.6631   93.4786   97.2940  101.1095  104.9249 (44)
Energy conte 155.6006  136.0893  140.4320  122.4320  117.4764  101.3732   93.9372  107.7943  109.0817  127.1242  138.7660  150.6909 (45)
Energy content (annual)                                                                        Total = Sum(45)m =  1500.7977 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
              23.3401   20.4134   21.0648   18.3648   17.6215   15.2060   14.0906   16.1691   16.3623   19.0686   20.8149   22.6036 (46)
Water storage loss:
Store volume                                                                                                      3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                      0.0212 (51)
  Volume factor from Table 2a                                                                                     3.4200 (52)
  Temperature factor from Table 2b                                                                                1.0000 (53)
Enter (49) or (54) in (55)                                                                                        0.2173 (55)
Total storage loss
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (57)
Primary loss  23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
             185.5983  163.1840  170.4297  151.4620  147.4741  130.4032  123.9349  137.7920  138.1117  157.1219  167.7960  180.6886 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                          Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
             185.5983  163.1840  170.4297  151.4620  147.4741  130.4032  123.9349  137.7920  138.1117  157.1219  167.7960  180.6886 (64)
                                                                           Total per year (kWh/year) = Sum(64)m =   1853.9964 (64)
Heat gains from water heating, kWh/month
              75.7354   66.9254   70.6918   63.9327   63.0591   56.9306   55.2323   59.8398   59.4937   66.2670   69.3637   74.1029 (65)


-------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              21.0367   18.6846   15.1953   11.5038    8.5993    7.2599    7.8445   10.1966   13.6859   17.3774   20.2820   21.6214 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             232.6818  235.0963  229.0118  216.0586  199.7076  184.3400  174.0734  171.6589  177.7434  190.6965  207.0476  222.4152 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813 (69)
Pumps, fans    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 (71)
Water heating gains (Table 5)
             101.7948   99.5914   95.0158   88.7954   84.7568   79.0703   74.2369   80.4298   82.6301   89.0685   96.3385   99.6006 (72)
Total internal gains
             417.1572  415.0163  400.8669  378.0018  354.7076  332.3141  317.7988  323.9293  335.7034  358.7864  385.3120  405.2812 (73)


-------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------

[Jan]                                       Area      Solar flux              g                FF          Access          Gains
                                              m2       Table 6a    Specific data    Specific data          factor              W
                                                           W/m2      or Table 6b      or Table 6c        Table 6d
-------------------------------------------------------------------------------------------
Southeast                                16.3500        36.7938           0.4000           0.7000          0.7700       116.7304 (77)
-------------------------------------------------------------------------------------------

Solar gains  116.7304  198.8351  272.0548  337.0891  377.5679  374.8376  361.3834  331.1844  294.5779  219.7551  139.8161   99.8969 (83)
Total gains  533.8877  613.8514  672.9218  715.0909  732.2756  707.1516  679.1823  655.1137  630.2812  578.5415  525.1281  505.1781 (84)


-------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           83.7673   84.0103   84.2547   85.4982   85.7514   87.0399   87.0399   87.3022   86.5198   85.7514   85.2466   84.7477
alpha          6.5845    6.6007    6.6170    6.6999    6.7168    6.8027    6.8027    6.8201    6.7680    6.7168    6.6831    6.6498
util living area
               0.9973    0.9926    0.9789    0.9326    0.8149    0.6155    0.4466    0.4819    0.7284    0.9476    0.9928    0.9981 (86)

MIT           20.2323   20.3740   20.5663   20.7871   20.9359   20.9919   20.9992   20.9987   20.9763   20.7906   20.4695   20.2061 (87)
Th 2          20.2283   20.2303   20.2324   20.2427   20.2448   20.2552   20.2552   20.2573   20.2510   20.2448   20.2407   20.2365 (88)
util rest of house
               0.9965    0.9904    0.9724    0.9126    0.7692    0.5481    0.3716    0.4051    0.6618    0.9277    0.9902    0.9975 (89)
MIT 2         19.1966   19.4042   19.6822   19.9969   20.1839   20.2499   20.2549   20.2567   20.2333   20.0083   19.5520   19.1648 (90)
Living area fraction                                                                     fLA = Living area / (4) =      0.4031 (91)
MIT           19.6141   19.7951   20.0386   20.3154   20.4870   20.5490   20.5549   20.5558   20.5328   20.3236   19.9219   19.5846 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  19.6141   19.7951   20.0386   20.3154   20.4870   20.5490   20.5549   20.5558   20.5328   20.3236   19.9219   19.5846 (93)


-------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9956    0.9887    0.9704    0.9147    0.7847    0.5751    0.4018    0.4361    0.6877    0.9301    0.9888    0.9968 (94)
Useful gains 531.5170  606.9419  653.0224  654.1085  574.5959  406.6810  272.9254  285.7060  433.4623  538.1008  519.2214  503.5588 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
            1099.4423 1066.2712  966.3501  802.9546  616.2494  411.0388  273.2592  286.2760  447.1366  681.9357  904.5452 1091.7259 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             422.5364  308.6693  233.1158  107.1691   30.9902    0.0000    0.0000    0.0000    0.0000  107.0132  277.4331  437.5963 (98)
Space heating                                                                                                  1924.5235 (98)
Space heating per m2                                                                                (98) / (4) =    22.2231 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303b)
Fraction of total space heat from community Heat pump	1.0000	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.3000	(306)
Space heating:		
Annual space heating requirement	1924.5235	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30	2501.8806	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1853.9964	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30	2410.1953	(310b)
Electricity used for heat distribution	49.1208	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)		
mechanical ventilation fans (SFP = 0.5500)	145.2715	(330a)
Total electricity for the above, kWh/year	145.2715	(331)
Electricity for lighting (calculated in Appendix L)	371.5144	(332)
Total delivered energy for all uses	5428.8618	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367b)
Space heating from Heat pump	1637.3586	0.5190	849.7891	(368)
Electrical energy for heat distribution	49.1208	0.5190	25.4937	(372)
Total CO2 associated with community systems			875.2828	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			875.2828	(376)
Pumps and fans	145.2715	0.5190	75.3959	(378)
Energy for lighting	371.5144	0.5190	192.8160	(379)
Total CO2, kg/year			1143.4947	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2000	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		13.2000	ZC1
Total Floor Area	TFA	86.6000	
Assumed number of occupants	N	2.5763	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.9217	ZC2
CO2 emissions from cooking, equation (L16)		2.0881	ZC3
Total CO2 emissions		31.2099	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.2099	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		86.6000 (1b)	x	2.5000 (2b)	=	216.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.6000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	216.5000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1386	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3886	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3011	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3840	0.3764	0.3689	0.3313	0.3237	0.2861	0.2861	0.2786	0.3011	0.3237	0.3388	0.3538	(22b)
Effective ac	0.5737	0.5708	0.5680	0.5549	0.5524	0.5409	0.5409	0.5388	0.5453	0.5524	0.5574	0.5626	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			16.3500	1.3258	21.6761			(27)
Exposed			86.6000	0.1300	11.2580			(28b)
External Wall	33.9000	16.3500	17.5500	0.1800	3.1590			(29a)
Wall to Stairwell	29.8500	2.1200	27.7300	0.1800	4.9914			(29a)
Total net area of external elements Aum(A, m2)			150.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.2045			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1385	(36)
Total fabric heat loss	(33) + (36) =	55.3430	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.9887	40.7842	40.5838	39.6423	39.4662	38.6462	38.6462	38.4943	38.9620	39.4662	39.8225	40.1951	(38)
Heat transfer coeff	96.3318	96.1273	95.9268	94.9853	94.8092	93.9892	93.9892	93.8373	94.3050	94.8092	95.1655	95.5381	(39)
Average = Sum(39)m / 12 =												94.9845	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1124	1.1100	1.1077	1.0968	1.0948	1.0853	1.0853	1.0836	1.0890	1.0948	1.0989	1.1032	(40)
HLP (average)												1.0968	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5763	(42)
Average daily hot water use (litres/day)	95.3863	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.9249	101.1095	97.2940	93.4786	89.6631	85.8477	85.8477	89.6631	93.4786	97.2940	101.1095	104.9249	(44)
Energy conte	155.6006	136.0893	140.4320	122.4320	117.4764	101.3732	93.9372	107.7943	109.0817	127.1242	138.7660	150.6909	(45)
Energy content (annual)											Total = Sum(45)m =	1500.7977	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3401	20.4134	21.0648	18.3648	17.6215	15.2060	14.0906	16.1691	16.3623	19.0686	20.8149	22.6036	(46)

Water storage loss:		
Store volume	3.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	0.2602	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.1405	(55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
              4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
              4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss 23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
            183.2183  161.0343  168.0496  149.1588  145.0941  128.1000  121.5549  135.4120  135.8085  154.7419  165.4928  178.3086 (62)
Solar input   0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                       Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
            183.2183  161.0343  168.0496  149.1588  145.0941  128.1000  121.5549  135.4120  135.8085  154.7419  165.4928  178.3086 (64)
                                                                        Total per year (kWh/year) = Sum(64)m =  1825.9736 (64)
Heat gains from water heating, kWh/month
             73.8313   65.2057   68.7878   62.0901   61.1550   55.0880   53.3283   57.9357   57.6511   64.3629   67.5211   72.1989 (65)
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-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m       128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132  128.8132 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
             21.0367   18.6846   15.1953   11.5038    8.5993    7.2599    7.8445   10.1966   13.6859   17.3774   20.2820   21.6214 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
            232.6818  235.0963  229.0118  216.0586  199.7076  184.3400  174.0734  171.6589  177.7434  190.6965  207.0476  222.4152 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
             35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813   35.8813 (69)
Pumps, fans   3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 -103.0506 (71)
Water heating gains (Table 5)
             99.2357   97.0323   92.4567   86.2362   82.1976   76.5111   71.6778   77.8706   80.0710   86.5093   93.7793   97.0415 (72)
Total internal gains
            417.5981  415.4571  401.3078  378.4426  355.1485  332.7549  318.2397  324.3701  336.1442  359.2272  385.7528  405.7220 (73)
```

```
-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------

[Jan]                                    Area      Solar flux             g            FF        Access          Gains
                                           m2        Table 6a  Specific data Specific data        factor              W
                                                         W/m2    or Table 6b   or Table 6c     Table 6d
-------------------------------------------------------------------------------------------------
Southeast                             16.3500         36.7938         0.6300        0.7000        0.7700       183.8504 (77)
-------------------------------------------------------------------------------------------------

Solar gains 183.8504  313.1653  428.4864  530.9154  594.6695  590.3692  569.1789  521.6155  463.9601  346.1143  220.2104  157.3376 (83)
Total gains 601.4485  728.6224  829.7941  909.3580  949.8180  923.1241  887.4185  845.9856  800.1043  705.3415  605.9632  563.0597 (84)
```

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-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                          21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          62.4289   62.5617   62.6925   63.3139   63.4315   63.9849   63.9849   64.0884   63.7706   63.4315   63.1940   62.9476
alpha         5.1619    5.1708    5.1795    5.2209    5.2288    5.2657    5.2657    5.2726    5.2514    5.2288    5.2129    5.1965
util living area
              0.9961    0.9891    0.9710    0.9199    0.8067    0.6261    0.4615    0.5029    0.7426    0.9436    0.9907    0.9972 (86)

MIT          19.8975   20.0966   20.3604   20.6574   20.8734   20.9741   20.9956   20.9932   20.9379   20.6490   20.2091   19.8585 (87)
Th 2         19.9907   19.9927   19.9945   20.0034   20.0051   20.0128   20.0128   20.0143   20.0098   20.0051   20.0017   19.9982 (88)
util rest of house
              0.9948    0.9857    0.9617    0.8945    0.7518    0.5401    0.3604    0.3990    0.6612    0.9201    0.9871    0.9963 (89)
MIT 2        18.5302   18.8204   19.1998   19.6165   19.8875   19.9965   20.0113   20.0116   19.9644   19.6157   18.9922   18.4789 (90)
Living area fraction                                                                  fLA = Living area / (4) =     0.4031 (91)
MIT          19.0814   19.3349   19.6677   20.0361   20.2849   20.3906   20.4081   20.4073   20.3569   20.0322   19.4827   19.0350 (92)
Temperature adjustment                                                                                              0.0000
adjusted MIT 19.0814   19.3349   19.6677   20.0361   20.2849   20.3906   20.4081   20.4073   20.3569   20.0322   19.4827   19.0350 (93)
```

```
-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation   0.9932    0.9827    0.9579    0.8955    0.7684    0.5740    0.4013    0.4410    0.6915    0.9209    0.9846    0.9950 (94)
Useful gains 597.3658  716.0106  794.8928  814.2945  729.8484  529.9017  356.1219  373.1127  553.2735  649.5301  596.6274  560.2493 (95)
Ext temp.     4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
           1423.9191 1387.5846 1263.1334 1057.7676  813.9311  544.2543  357.9188  376.0366  590.0550  894.2602 1178.4109 1417.3122 (97)
Month fracti  1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
            614.9556  451.2977  348.3709  175.3007   62.5576    0.0000    0.0000    0.0000    0.0000  182.0792  418.8841  637.6548 (98)
Space heating                                                                                                    2891.1006 (98)
Space heating per m2                                                                              (98) / (4) =     33.3845 (99)
```

```
-------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-------------------------------------------------------------------------------------------------
Not applicable
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
-------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                0.0000 (201)
Fraction of space heat from main system(s)                                                                           1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                    93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                              0.0000 (208)
Space heating requirement                                                                                         3092.0862 (211)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
            614.9556  451.2977  348.3709  175.3007   62.5576    0.0000    0.0000    0.0000    0.0000  182.0792  418.8841  637.6548 (98)
Space heating efficiency (main heating system 1)
             93.5000   93.5000   93.5000   93.5000   93.5000    0.0000    0.0000    0.0000    0.0000   93.5000   93.5000   93.5000 (210)
Space heating fuel (main heating system)
            657.7066  482.6714  372.5892  187.4873   66.9065    0.0000    0.0000    0.0000    0.0000  194.7371  448.0044  681.9837 (211)
Water heating requirement
              0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
            183.2183  161.0343  168.0496  149.1588  145.0941  128.1000  121.5549  135.4120  135.8085  154.7419  165.4928  178.3086 (64)
Efficiency of water heater                                                                                          79.8000 (216)
(217)m       87.7977   87.4174   86.7163   85.2454   82.7474   79.8000   79.8000   79.8000   79.8000   85.2486   87.1892   87.9237 (217)
Fuel for water heating, kWh/month
            208.6824  184.2130  193.7924  174.9758  175.3459  160.5263  152.3244  169.6892  170.1861  181.5184  189.8088  202.7991 (219)
Water heating fuel used                                                                                           2163.8616 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                  3092.0862 (211)
Space heating fuel - secondary                                                                                       0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                             30.0000 (230c)
   main heating flue fan                                                                                            45.0000 (230e)
Total electricity for the above, kWh/year                                                                           75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                371.5144 (232)
Total delivered energy for all uses                                                                               5702.4621 (238)
```

```
-------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-------------------------------------------------------------------------------------------------
                                                                        Energy   Emission factor        Emissions
                                                                      kWh/year       kg CO2/kWh       kg CO2/year
Space heating - main system 1                                        3092.0862           0.2160          667.8906 (261)
Space heating - secondary                                               0.0000           0.0000            0.0000 (263)
Water heating (other fuel)                                           2163.8616           0.2160          467.3941 (264)
Space and water heating                                                                                 1135.2847 (265)
Pumps and fans                                                         75.0000           0.5190           38.9250 (267)
Energy for lighting                                                   371.5144           0.5190          192.8160 (268)
Total CO2, kg/m2/year                                                                                   1367.0257 (272)
Emissions per m2 for space and water heating                                                              13.1095 (272a)
Fuel factor (electricity)                                                                                  1.5500
Emissions per m2 for lighting                                                                              2.2265 (272b)
Emissions per m2 for pumps and fans                                                                        0.4495 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.1095 * 1.55) + 2.2265 + 0.4495, rounded to 2 d.p.         23.0000 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 003 E1 - 1B1P	**Issued on Date**	15/12/2020
Assessment Reference	1B1P Be Clean	**Prop Type Ref**	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	80 C	**DER**	19.93	**TER**	35.48
Environmental	89 B	**% DER<TER**	43.82		
CO_2 Emissions (t/year)	0.65	**DFEE**	59.39	**TFEE**	56.20
General Requirements Compliance	Fail	**% DFEE<TFEE**	-5.68		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 40 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
--------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 35.48 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.93 kgCO□/m²OK
--------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)59.4 kWh/m²/yrFail
Excess energy =3.2 kWh/m²/yr  (5.7%)
--------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.32 (max. 2.00)       1.40 (max. 3.30)          OK
--------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
--------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                              OK
--------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Community heating scheme                          -

Secondary heating system:              None
--------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:            No primary pipework
--------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                    No cylinderstat


--------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                               OK
--------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.42
Maximum                                1.5                                               OK
MVHR efficiency:                       91%
Minimum:                               70%                                               OK
--------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):           Medium                                            OK
Based on:
Overshading:                           Average
Windows facing North East:             2.55 m², No overhang
Windows facing North West:             10.75 m², No overhang
Air change rate:                       2.00 ach
Blinds/curtains:                       None
--------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                     0.00 W/m²K
Door U-value                           0.82 W/m²K
Air permeability                       3.0 m³/m²h



--------------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------
                                                                      Area          Storey height              Volume
                                                                      (m2)                (m)                   (m3)
Ground floor                                                       40.3000 (1b)    x     2.5000 (2b)    =    100.7500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          40.3000                                            (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    100.7500 (5)


-----------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------
                                                     main         secondary           other            total       m3 per hour
                                                   heating         heating
Number of chimneys                                    0      +        0      +          0      =          0 * 40 =     0.0000 (6a)
Number of open flues                                  0      +        0      +          0      =          0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                               0 * 10 =     0.0000 (7a)
Number of passive vents                                                                                   0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                              0 * 40 =     0.0000 (7c)

                                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                       0.0000 / (5) =     0.0000 (8)
Pressure test                                                                                                           Yes
Measured/design AP50                                                                                                 3.0000
Infiltration rate                                                                                                    0.1500 (18)
Number of sides sheltered                                                                                                 3 (19)

Shelter factor                                                                   (20) =  1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                     (21) = (18) x (20)   =     0.1163 (21)


                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed     5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor    1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
               0.1482    0.1453    0.1424    0.1279    0.1250    0.1104    0.1104    0.1075    0.1163    0.1250    0.1308    0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                           0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                        77.3500 (23c)

Effective ac   0.2615    0.2586    0.2557    0.2411    0.2382    0.2237    0.2237    0.2208    0.2295    0.2382    0.2440    0.2498 (25)


-----------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------
Element                                       Gross      Openings      NetArea      U-value        A x U       K-value        A x K
                                                 m2            m2           m2       W/m2K          W/K        kJ/m2K         kJ/K
Window Double-Glazed (Uw = 1.40)                                       13.3000      1.3258      17.6326                           (27)
Door                                                                    2.1200      0.8200       1.7384                           (26)
External Wall                               22.8300       13.3000      9.5300      0.1800       1.7154                           (29a)
Wall to CA                                  40.7500        2.1200     38.6300      0.1671       6.4539                           (29a)
Total net area of external elements Aum(A, m2)                         63.5800                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                   (26)...(30) + (32) =   27.5402                           (33)
Party Wall 1                                                           14.0500      0.0000       0.0000                           (32)
Party Floor 1                                                          40.3000                                                   (32d)
Party Ceilings 1                                                       40.3000                                                   (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                  250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                           8.4248 (36)
Total fabric heat loss                                                                              (33) + (36) =   35.9650 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m          8.6932    8.5966    8.4999    8.0168    7.9202    7.4371    7.4371    7.3404    7.6303    7.9202    8.1134    8.3067 (38)
Heat transfer coeff
              44.6582   44.5616   44.4650   43.9818   43.8852   43.4021   43.4021   43.3055   43.5953   43.8852   44.0785   44.2717 (39)
Average = Sum(39)m / 12 =                                                                                           43.9577 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            1.1081    1.1057    1.1033    1.0914    1.0890    1.0770    1.0770    1.0746    1.0818    1.0890    1.0938    1.0986 (40)
HLP (average)                                                                                                        1.0908 (40)
Days in month
                   31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------
Assumed occupancy                                                                                                    1.4143 (42)
Average daily hot water use (litres/day)                                                                            67.7904 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
              74.5694   71.8578   69.1462   66.4346   63.7230   61.0113   61.0113   63.7230   66.4346   69.1462   71.8578   74.5694 (44)
Energy conte 110.5843   96.7177   99.8040   87.0116   83.4897   72.0452   66.7605   76.6087   77.5236   90.3463   98.6201  107.0950 (45)
Energy content (annual)                                                                          Total = Sum(45)m =  1066.6067 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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              16.5876   14.5077   14.9706   13.0517   12.5235   10.8068   10.0141   11.4913   11.6285   13.5519   14.7930   16.0642 (46)
Water storage loss:
Store volume                                                                                                         3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                        0.0212 (51)
  Volume factor from Table 2a                                                                                        3.4200 (52)
  Temperature factor from Table 2b                                                                                   1.0000 (53)
Enter (49) or (54) in (55)                                                                                           0.2173 (55)
Total storage loss
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (57)
Primary loss  23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
             140.5820  123.8124  129.8017  116.0416  113.4874  101.0753   96.7582  106.6064  106.5536  120.3440  127.6501  137.0927 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                             Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
             140.5820  123.8124  129.8017  116.0416  113.4874  101.0753   96.7582  106.6064  106.5536  120.3440  127.6501  137.0927 (64)
                                                                              Total per year (kWh/year) = Sum(64)m =  1419.8054 (64)
Heat gains from water heating, kWh/month
              60.7674   53.8344   57.1830   52.1554   51.7585   47.1791   46.1960   49.4705   49.0006   54.0383   56.0152   59.6072 (65)


-----------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m         70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166   70.7166 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              10.9021    9.6832    7.8749    5.9618    4.4565    3.7624    4.0654    5.2843    7.0926    9.0057   10.5110   11.2051 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             122.2887  123.5576  120.3599  113.5522  104.9587   96.8821   91.4864   90.2174   93.4152  100.2228  108.8163  116.8930 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717   30.0717 (69)
Pumps, fans    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733  -56.5733 (71)
Water heating gains (Table 5)
              81.6767   80.1107   76.8589   72.4380   69.5678   65.5265   62.0914   66.4927   68.0564   72.6321   77.7989   80.1173 (72)
Total internal gains
             259.0824  257.5665  249.3086  236.1670  223.1980  210.3859  201.8581  206.2094  212.7792  226.0756  241.3412  252.4303 (73)


-----------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------
[Jan]                                 Area      Solar flux            g              FF          Access             Gains
                                        m2       Table 6a   Specific data   Specific data         factor                 W
                                                     W/m2    or Table 6b     or Table 6c       Table 6d
-----------------------------------------------------------------------------------------
Northeast                           2.5500        11.2829         0.4000          0.7000         0.7700            5.5828 (75)
Northwest                          10.7500        11.2829         0.4000          0.7000         0.7700           23.5354 (81)
-----------------------------------------------------------------------------------------

Solar gains   29.1182   59.2710  106.7876  175.3758  235.7395  251.3233  235.1078  187.4307  130.1223   72.4339   36.6383   23.7794 (83)
Total gains  288.2007  316.8375  356.0961  411.5428  458.9376  461.7092  436.9659  393.6400  342.9015  298.5096  277.9794  276.2098 (84)


-----------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                        21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           62.6673   62.8032   62.9397   63.6310   63.7711   64.4810   64.4810   64.6249   64.1952   63.7711   63.4916   63.2144
alpha          5.1778    5.1869    5.1960    5.2421    5.2514    5.2987    5.2987    5.3083    5.2797    5.2514    5.2328    5.2143
util living area
               0.9955    0.9919    0.9790    0.9263    0.7870    0.5847    0.4340    0.4992    0.7810    0.9600    0.9912    0.9964 (86)

MIT           19.9224   20.0528   20.3040   20.6444   20.8894   20.9816   20.9968   20.9937   20.9222   20.5997   20.2061   19.8978 (87)
Th 2          19.9942   19.9961   19.9981   20.0079   20.0099   20.0197   20.0197   20.0216   20.0157   20.0099   20.0059   20.0020 (88)
util rest of house
               0.9941    0.9892    0.9719    0.9024    0.7306    0.5024    0.3389    0.3966    0.7024    0.9420    0.9878    0.9952 (89)
MIT 2         18.5689   18.7599   19.1234   19.6037   19.9085   20.0083   20.0186   20.0192   19.9568   19.5550   18.9911   18.5387 (90)
Living area fraction                                                                    fLA = Living area / (4) =     0.7983 (91)
MIT           19.6494   19.7920   20.0658   20.4344   20.6915   20.7852   20.7995   20.7971   20.7274   20.3890   19.9610   19.6236 (92)
Temperature adjustment                                                                                                0.0000
adjusted MIT  19.6494   19.7920   20.0658   20.4344   20.6915   20.7852   20.7995   20.7971   20.7274   20.3890   19.9610   19.6236 (93)


-----------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9934    0.9886    0.9725    0.9135    0.7706    0.5672    0.4147    0.4784    0.7611    0.9497    0.9876    0.9947 (94)
Useful gains 286.3107  313.2227  346.2888  375.9537  353.6380  261.8856  181.2286  188.3141  260.9810  283.5029  274.5364  274.7371 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
             685.4748  663.6102  603.2032  507.3047  394.5932  268.4512  182.2659  190.4171  288.9242  429.5917  566.8942  682.8289 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             296.9781  235.4604  191.1443   94.5727   30.4707    0.0000    0.0000    0.0000    0.0000  108.6900  210.4976  303.6203 (98)
Space heating                                                                                                     1471.4342 (98)
Space heating per m2                                                                                   (98) / (4) =   36.5120 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                    0.0000 (301)
Fraction of space heat from community system                                             1.0000 (302)
Fraction of heat from community Heat pump                                                1.0000 (303b)
Fraction of total space heat from community Heat pump                                    1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating         1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating         1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                        1.3000 (306)
Space heating:
Annual space heating requirement                                                      1471.4342 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                 1912.8644 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                    0.0000 (309)

Water heating
Annual water heating requirement                                                      1419.8054 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                 1845.7470 (310b)
Electricity used for heat distribution                                                  37.5861 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                     64.5304 (330a)
Total electricity for the above, kWh/year                                               64.5304 (331)
Electricity for lighting (calculated in Appendix L)                                    192.5349 (332)
Total delivered energy for all uses                                                   4015.6767 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                   Energy     Emission factor         Emissions
                                                                kWh/year         kg CO2/kWh        kg CO2/year
Efficiency of heat source Heat pump                                                                300.0000 (367b)
Space heating from Heat pump                                   1252.8705             0.5190        650.2398 (368)
Electrical energy for heat distribution                          37.5861             0.5190         19.5072 (372)
Total CO2 associated with community systems                                                        669.7470 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                            669.7470 (376)
Pumps and fans                                                   64.5304             0.5190         33.4913 (378)
Energy for lighting                                             192.5349             0.5190         99.9256 (379)
Total CO2, kg/year                                                                                 803.1638 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                         19.9300 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                 19.9300 ZC1
Total Floor Area                                                                          TFA       40.3000
Assumed number of occupants                                                                 N        1.4143
CO2 emission factor in Table 12 for electricity displaced from grid                        EF        0.5190
CO2 emissions from appliances, equation (L14)                                                       17.9816 ZC2
CO2 emissions from cooking, equation (L16)                                                           3.7951 ZC3
Total CO2 emissions                                                                                 41.7067 ZC4
Residual CO2 emissions offset from biofuel CHP                                                       0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                             0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                      0.0000 ZC7
Net CO2 emissions                                                                                   41.7067 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                         Area          Storey height            Volume
                                                                         (m2)                (m)                 (m3)
Ground floor                                                      40.3000 (1b)    x       2.5000 (2b)    =    100.7500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        40.3000                                              (4)
Dwelling volume                                                      (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =        100.7500 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                               main          secondary            other           total       m3 per hour
                                             heating           heating
Number of chimneys                                0      +           0      +         0     =        0 * 40 =     0.0000 (6a)
Number of open flues                              0      +           0      +         0     =        0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                          2 * 10 =    20.0000 (7a)
Number of passive vents                                                                              0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                         0 * 40 =     0.0000 (7c)

                                                                                              Air changes per hour
Infiltration due to chimneys, flues and fans    = (6a)+(6b)+(7a)+(7b)+(7c) =              20.0000 / (5) =     0.1985 (8)
Pressure test                                                                                                   Yes
Measured/design AP50                                                                                         5.0000
Infiltration rate                                                                                            0.4485 (18)
Number of sides sheltered                                                                                         3 (19)

Shelter factor                                                             (20) =  1  -  [0.075 x (19)]  =   0.7750 (20)
Infiltration rate adjusted to include shelter factor                               (21) = (18) x (20)    =   0.3476 (21)


                   Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed      5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor     1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
                0.4432    0.4345    0.4258    0.3824    0.3737    0.3302    0.3302    0.3215    0.3476    0.3737    0.3910    0.4084 (22b)
Effective ac    0.5982    0.5944    0.5907    0.5731    0.5698    0.5545    0.5545    0.5517    0.5604    0.5698    0.5765    0.5834 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                  Gross       Openings       NetArea       U-value        A x U      K-value        A x K
                                            m2             m2            m2         W/m2K          W/K        kJ/m2K        kJ/K
TER Opaque door                                                      2.1200        1.0000       2.1200                          (26)
TER Opening Type (Uw = 1.40)                                         7.9600        1.3258      10.5530                          (27)
External Wall                          22.8300         7.9600       14.8700        0.1800       2.6766                          (29a)
Wall to CA                             40.7500         2.1200       38.6300        0.1800       6.9534                          (29a)
Total net area of external elements Aum(A, m2)                      63.5800                                                     (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =   22.3030                          (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                   250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                            5.3077 (36)
Total fabric heat loss                                                                          (33) + (36) =        27.6107 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                   Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m          19.8889   19.7621   19.6378   19.0541   18.9449   18.4365   18.4365   18.3423   18.6323   18.9449   19.1658   19.3968 (38)
Heat transfer coeff
               47.4996   47.3728   47.2485   46.6648   46.5556   46.0472   46.0472   45.9530   46.2430   46.5556   46.7765   47.0075 (39)
Average = Sum(39)m / 12 =                                                                                                46.6643 (39)

                   Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP             1.1787    1.1755    1.1724    1.1579    1.1552    1.1426    1.1426    1.1403    1.1475    1.1552    1.1607    1.1664 (40)
HLP (average)                                                                                                             1.1579 (40)
Days in month
                    31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                         1.4143 (42)
Average daily hot water use (litres/day)                                                                                 67.7904 (43)

                   Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
               74.5694   71.8578   69.1462   66.4346   63.7230   61.0113   61.0113   63.7230   66.4346   69.1462   71.8578   74.5694 (44)
Energy conte  110.5843   96.7177   99.8040   87.0116   83.4897   72.0452   66.7605   76.6087   77.5236   90.3463   98.6201  107.0950 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1066.6067 (45)
Distribution loss  (46)m = 0.15 x (45)m
               16.5876   14.5077   14.9706   13.0517   12.5235   10.8068   10.0141   11.4913   11.6285   13.5519   14.7930   16.0642 (46)
Water storage loss:
Store volume                                                                                                              3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                             0.2602 (48)
  Temperature factor from Table 2b                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
                4.3553      3.9338      4.3553      4.2148      4.3553      4.2148      4.3553      4.3553      4.2148      4.3553      4.2148      4.3553 (56)
If cylinder contains dedicated solar storage
                4.3553      3.9338      4.3553      4.2148      4.3553      4.2148      4.3553      4.3553      4.2148      4.3553      4.2148      4.3553 (57)
Primary loss   23.2624     21.0112     23.2624     22.5120     23.2624     22.5120     23.2624     23.2624     22.5120     23.2624     22.5120     23.2624 (59)
Total heat required for water heating calculated for each month
              138.2020    121.6627    127.4217    113.7384    111.1074     98.7720     94.3782    104.2263    104.2504    117.9640    125.3468    134.7127 (62)
Solar input     0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63)
                                                                                    Solar input (sum of months) = Sum(63)m =          0.0000 (63)
Output from w/h
              138.2020    121.6627    127.4217    113.7384    111.1074     98.7720     94.3782    104.2263    104.2504    117.9640    125.3468    134.7127 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =       1391.7826 (64)
Heat gains from water heating, kWh/month
               58.8634     52.1146     55.2790     50.3128     49.8545     45.3365     44.2920     47.5665     47.1580     52.1343     54.1726     57.7032 (65)


-----------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(66)m          70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166     70.7166 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               10.9938      9.7646      7.9411      6.0119      4.4940      3.7940      4.0996      5.3288      7.1522      9.0814     10.5993     11.2993 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              122.2887    123.5576    120.3599    113.5522    104.9587     96.8821     91.4864     90.2174     93.4152    100.2228    108.8163    116.8930 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717     30.0717 (69)
Pumps, fans     3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733    -56.5733 (71)
Water heating gains (Table 5)
               79.1175     77.5516     74.2997     69.8789     67.0087     62.9673     59.5323     63.9335     65.4973     70.0730     75.2397     77.5581 (72)
Total internal gains
              259.6149    258.0887    249.8156    236.6579    223.6763    210.8584    202.3332    206.6946    213.2796    226.5922    241.8703    252.9654 (73)


-----------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------

[Jan]                                     Area         Solar flux               g              FF            Access              Gains
                                            m2           Table 6a    Specific data   Specific data            factor                  W
                                                             W/m2      or Table 6b     or Table 6c          Table 6d
-----------------------------------------------------------------------------------------------
Northeast                               1.5300            11.2829          0.6300          0.7000            0.7700             5.2758 (75)
Northwest                               6.4300            11.2829          0.6300          0.7000            0.7700            22.1720 (81)
-----------------------------------------------------------------------------------------------

Solar gains    27.4478     55.8707    100.6613    165.3148    222.2155    236.9053    221.6200    176.6781    122.6574     68.2785     34.5364     22.4152 (83)
Total gains   287.0627    313.9595    350.4770    401.9727    445.8919    447.7636    423.9532    383.3727    335.9370    294.8707    276.4068    275.3806 (84)


-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                     21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau            58.9186     59.0763     59.2317     59.9726     60.1133     60.7770     60.7770     60.9016     60.5197     60.1133     59.8294     59.5354
alpha           4.9279      4.9384      4.9488      4.9982      5.0076      5.0518      5.0518      5.0601      5.0346      5.0076      4.9886      4.9690
util living area
                0.9957      0.9926      0.9820      0.9394      0.8210      0.6286      0.4718      0.5389      0.8121      0.9656      0.9919      0.9965 (86)

MIT            19.8237     19.9537     20.2087     20.5648     20.8443     20.9691     20.9940     20.9888     20.8921     20.5356     20.1254     19.8027 (87)
Th 2           20.4107     20.4122     20.4138     20.4210     20.4224     20.4287     20.4287     20.4299     20.4263     20.4224     20.4196     20.4168 (88)
util rest of house
                0.9950      0.9914      0.9787      0.9285      0.7923      0.5805      0.4129      0.4767      0.7718      0.9575      0.9903      0.9959 (89)
MIT 2          19.2988     19.4296     19.6841     20.0385     20.2995     20.4089     20.4258     20.4242     20.3487     20.0151     19.6071     19.2828 (90)
Living area fraction                                                                                 fLA = Living area / (4) =       0.7983 (91)
MIT            19.7178     19.8480     20.1029     20.4586     20.7344     20.8561     20.8794     20.8749     20.7825     20.4306     20.0209     19.6978 (92)
Temperature adjustment                                                                                                                0.6000
adjusted MIT   20.3178     20.4480     20.7029     21.0586     21.3344     21.4561     21.4794     21.4749     21.3825     21.0306     20.6209     20.2978 (93)


-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation     0.9949      0.9914      0.9804      0.9404      0.8360      0.6646      0.5197      0.5880      0.8353      0.9660      0.9909      0.9958 (94)
Useful gains  285.5919    311.2710    343.6066    378.0108    372.7640    297.5855    220.3160    225.4407    280.6132    284.8445    273.8846    274.2243 (95)
Ext temp.       4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000 (96)
Heat loss rate W
              760.8378    736.5511    671.0639    567.3784    448.5350    315.7047    224.6819    233.2071    336.7647    485.6041    632.4585    756.7189 (97)
Month fracti    1.0000      1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
Space heating kWh
              353.5829    285.7882    243.6282    136.3447     56.3736      0.0000      0.0000      0.0000      0.0000    149.3651    258.1732    358.9760 (98)
Space heating                                                                                                                      1842.2319 (98)
Space heating per m2                                                                                         (98) / (4) =       45.7130 (99)


-----------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------
Not applicable
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                     88.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                               0.0000 (208)
Space heating requirement                                                                                          2081.6180 (211)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Space heating requirement
              353.5829    285.7882    243.6282    136.3447     56.3736      0.0000      0.0000      0.0000      0.0000    149.3651    258.1732    358.9760 (98)
Space heating efficiency (main heating system 1)
               88.5000     88.5000     88.5000     88.5000     88.5000      0.0000      0.0000      0.0000      0.0000     88.5000     88.5000     88.5000 (210)
Space heating fuel (main heating system)
              399.5287    322.9246    275.2861    154.0618     63.6990      0.0000      0.0000      0.0000      0.0000    168.7741    291.7211    405.6226 (211)
Water heating requirement
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (215)

Water heating
Water heating requirement
              138.2020    121.6627    127.4217    113.7384    111.1074     98.7720     94.3782    104.2263    104.2504    117.9640    125.3468    134.7127 (64)
Efficiency of water heater                                                                                           74.8000 (216)
(217)m         82.1958     81.9976     81.4966     80.2773     78.0894     74.8000     74.8000     74.8000     74.8000     80.4235     81.6812     82.2880 (217)
Fuel for water heating, kWh/month
              168.1376    148.3735    156.3522    141.6819    142.2822    132.0482    126.1740    139.3400    139.3722    146.6786    153.4587    163.7087 (219)
Water heating fuel used                                                                                            1757.6078 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                   2081.6180 (211)
Space heating fuel - secondary                                                                                        0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                              39.0000 (230c)
   main heating flue fan                                                                                             45.0000 (230e)
Total electricity for the above, kWh/year                                                                            84.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                 194.1534 (232)
Total delivered energy for all uses                                                                                4117.3792 (238)


-----------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------
                                                                            Energy     Emission factor          Emissions
                                                                          kWh/year         kg CO2/kWh        kg CO2/year
Space heating - main system 1                                            2081.6180             0.2160           449.6295 (261)
Space heating - secondary                                                   0.0000             0.0000             0.0000 (263)
Water heating (other fuel)                                               1757.6078             0.2160           379.6433 (264)
Space and water heating                                                                                         829.2728 (265)
Pumps and fans                                                             84.0000             0.5190            43.5960 (267)
Energy for lighting                                                       194.1534             0.5190           100.7656 (268)
Total CO2, kg/m2/year                                                                                           973.6344 (272)
Emissions per m2 for space and water heating                                                                     20.5775 (272a)
Fuel factor (electricity)                                                                                         1.5500
Emissions per m2 for lighting                                                                                     2.5004 (272b)
Emissions per m2 for pumps and fans                                                                               1.0818 (272c)
Target Carbon Dioxide Emission Rate (TER) = (20.5775 * 1.55) + 2.5004 + 1.0818, rounded to 2 d.p.                35.4800 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 004 C1 - 1B2P	**Issued on Date**	15/12/2020
Assessment Reference	1B2P Be Clean	**Prop Type Ref**	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	12.83	**TER**	22.75
Environmental	92 A	**% DER<TER**	43.61		
CO_2 Emissions (t/year)	0.55	**DFEE**	30.57	**TFEE**	31.39
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.61		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
--------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.75 kgCO2/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.83 kgCO2/m²OK
--------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)31.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.6 kWh/m²/yrOK
--------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.26 (max. 2.00)        1.40 (max. 3.30)          OK
--------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
--------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
--------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
--------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                         OK
Primary pipework insulated:             No primary pipework
--------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


--------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
--------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.42
Maximum                                 1.5                                               OK
MVHR efficiency:                        91%
Minimum:                                70%                                               OK
--------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                            OK
Based on:
Overshading:                            Average
Windows facing South East:              6.98 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
--------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                        Area        Storey height            Volume
                                                                        (m2)             (m)                  (m3)
Ground floor                                                         50.4000 (1b)    x     2.5000 (2b)    =    126.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        50.4000                                                 (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    126.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                        main          secondary            other              total       m3 per hour
                                                      heating          heating
Number of chimneys                                          0      +          0      +          0      =          0 * 40 =      0.0000 (6a)
Number of open flues                                        0      +          0      +          0      =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                       0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                           0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                      0 * 40 =      0.0000 (7c)

                                                                                                           Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                     Yes
Measured/design AP50                                                                                                           3.0000
Infiltration rate                                                                                                              0.1500 (18)
Number of sides sheltered                                                                                                           3 (19)

Shelter factor                                                                           (20) =  1  -  [0.075 x (19)]  =       0.7750 (20)
Infiltration rate adjusted to include shelter factor                                              (21) = (18) x (20)   =       0.1163 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed     5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor    1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
               0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                     0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                  77.3500 (23c)

Effective ac   0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)



-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                        Gross       Openings        NetArea       U-value          A x U        K-value          A x K
                                                  m2             m2             m2         W/m2K            W/K         kJ/m2K           kJ/K
Window Double-Glazed (Uw = 1.40)                                            6.9800        1.3258         9.2538                              (27)
Door                                                                        2.1200        0.8200         1.7384                              (26)
External Wall                                18.0800         6.9800        11.1000        0.1800         1.9980                              (29a)
Wall to Stairwell                            20.0500         2.1200        17.9300        0.1671         2.9955                              (29a)
Total net area of external elements Aum(A, m2)                             38.1300                                                           (31)
Fabric heat loss, W/K = Sum (A x U)                                          (26)...(30) + (32) =       15.9857                              (33)
Party Wall 1                                                               34.3500        0.0000         0.0000                              (32)
Party Floor 1                                                              50.4000                                                           (32d)
Party Ceilings 1                                                           50.4000                                                           (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                           250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                    5.6066 (36)
Total fabric heat loss                                                                                      (33) + (36) =    21.5923 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m         10.8719    10.7510    10.6302    10.0260     9.9051     9.3009     9.3009     9.1801     9.5426     9.9051    10.1468    10.3885 (38)
Heat transfer coeff
              32.4642    32.3434    32.2225    31.6183    31.4975    30.8933    30.8933    30.7724    31.1349    31.4975    31.7392    31.9808 (39)
Average = Sum(39)m / 12 =                                                                                                    31.5881 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            0.6441     0.6417     0.6393     0.6273     0.6249     0.6130     0.6130     0.6106     0.6178     0.6249     0.6297     0.6345 (40)
HLP (average)                                                                                                                 0.6267 (40)
Days in month
                   31         28         31         30         31         30         31         31         30         31         30         31 (41)



-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                             1.7019 (42)
Average daily hot water use (litres/day)                                                                                     74.6197 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              82.0817    79.0969    76.1121    73.1273    70.1425    67.1577    67.1577    70.1425    73.1273    76.1121    79.0969    82.0817 (44)
Energy conte 121.7248   106.4613   109.8585    95.7773    91.9006    79.3032    73.4861    84.3264    85.3335    99.4480   108.5552   117.8839 (45)
Energy content (annual)                                                                                Total = Sum(45)m =  1174.0587 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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              18.2587    15.9692    16.4788    14.3666    13.7851    11.8955    11.0229    12.6490    12.8000    14.9172    16.2833    17.6826 (46)
Water storage loss:
Store volume                                                                                                                  3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                  0.0212 (51)
  Volume factor from Table 2a                                                                                                 3.4200 (52)
  Temperature factor from Table 2b                                                                                            1.0000 (53)
Enter (49) or (54) in (55)                                                                                                    0.2173 (55)
Total storage loss
               6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             151.7225   133.5560   139.8562   124.8073   121.8983   108.3332   103.4838   114.3241   114.3635   129.4456   137.5852   147.8816 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
             151.7225   133.5560   139.8562   124.8073   121.8983   108.3332   103.4838   114.3241   114.3635   129.4456   137.5852   147.8816 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =  1527.2573 (64)
Heat gains from water heating, kWh/month
              64.4716    57.0741    60.5261    55.0700    54.5551    49.5923    48.4323    52.0367    51.5974    57.0646    59.3186    63.1946 (65)



-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941    85.0941 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              14.2147    12.6253    10.2676     7.7732     5.8106     4.9055     5.3006     6.8899     9.2477    11.7420    13.7047    14.6097 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             148.2728   149.8114   145.9342   137.6800   127.2605   117.4677   110.9256   109.3869   113.2642   121.5184   131.9378   141.7306 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094    31.5094 (69)
Pumps, fans    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753   -68.0753 (71)
Water heating gains (Table 5)
              86.6554    84.9317    81.3523    76.4861    73.3267    68.8783    65.0972    69.9418    71.6631    76.6997    82.3870    84.9389 (72)
Total internal gains
             297.6711   295.8967   286.0823   270.4675   254.9261   239.7798   229.8516   234.7469   242.7032   258.4884   276.5577   289.8075 (73)



-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------
[Jan]                                      Area       Solar flux              g                FF          Access            Gains
                                             m2         Table 6a   Specific data    Specific data          factor                W
                                                            W/m2     or Table 6b      or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
Southeast                                6.9800          36.7938          0.4000           0.7000          0.7700          49.8335 (77)
-----------------------------------------------------------------------------------------------------

Solar gains   49.8335    84.8850   116.1433   143.9072   161.1880   160.0224   154.2787   141.3864   125.7586    93.8160    59.6891    42.6471 (83)
Total gains  347.5047   380.7817   402.2256   414.3747   416.1141   399.8022   384.1302   376.1333   368.4618   352.3043   336.2468   332.4546 (84)



-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          107.8111   108.2139   108.6197   110.6954   111.1200   113.2933   113.2933   113.7382   112.4139   111.1200   110.2739   109.4405
alpha          8.1874     8.2143     8.2413     8.3797     8.4080     8.5529     8.5529     8.5825     8.4943     8.4080     8.3516     8.2960
util living area
               0.9904     0.9782     0.9460     0.8544     0.6926     0.4939     0.3538     0.3763     0.5805     0.8584     0.9733     0.9928 (86)

MIT           20.5937    20.6956    20.8218    20.9412    20.9903    20.9995    21.0000    21.0000    20.9981    20.9482    20.7655    20.5739 (87)
Th 2          20.3904    20.3926    20.3947    20.4054    20.4076    20.4183    20.4183    20.4205    20.4140    20.4076    20.4033    20.3990 (88)
util rest of house
               0.9878     0.9726     0.9332     0.8269     0.6522     0.4493     0.3071     0.3289     0.5323     0.8264     0.9655     0.9908 (89)
MIT 2         19.8520    19.9994    20.1769    20.3416    20.3989    20.4180    20.4183    20.4205    20.4127    20.3540    20.1091    19.8308 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.5843 (91)
MIT           20.2854    20.4062    20.5537    20.6920    20.7445    20.7578    20.7582    20.7591    20.7548    20.7012    20.4926    20.2650 (92)
Temperature adjustment                                                                                                        0.0000
adjusted MIT  20.2854    20.4062    20.5537    20.6920    20.7445    20.7578    20.7582    20.7591    20.7548    20.7012    20.4926    20.2650 (93)



-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9873     0.9728     0.9368     0.8406     0.6754     0.4754     0.3344     0.3566     0.5605     0.8429     0.9668     0.9903 (94)
Useful gains 343.0886   370.4195   376.7955   348.3103   281.0556   190.0605   128.4532   134.1272   206.5107   296.9437   325.0798   329.2276 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             518.9528   501.5233   452.8472   372.8433   284.8786   190.2344   128.4605   134.1396   207.1958   318.1621   425.0713   513.7715 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             130.8430    88.1018    56.5825    17.6637     2.8444     0.0000     0.0000     0.0000     0.0000    15.7865    71.9939   137.3007 (98)
Space heating                                                                                                               521.1163 (98)
Space heating per m2                                                                                       (98) / (4) =     10.3396 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable


----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                             0.0000 (301)
Fraction of space heat from community system                                                                      1.0000 (302)
Fraction of heat from community Heat pump                                                                         1.0000 (303b)
Fraction of total space heat from community Heat pump                                                             1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating                                  1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                                  1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                                 1.3000 (306)
Space heating:
Annual space heating requirement                                                                                521.1163 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                                           677.4512 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                           0.0000 (308)
Space heating fuel for secondary/supplementary system                                                             0.0000 (309)

Water heating
Annual water heating requirement                                                                               1527.2573 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                                          1985.4345 (310b)
Electricity used for heat distribution                                                                           26.6289 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                                              80.7030 (330a)
Total electricity for the above, kWh/year                                                                        80.7030 (331)
Electricity for lighting (calculated in Appendix L)                                                             251.0355 (332)
Total delivered energy for all uses                                                                            2994.6243 (338)


----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
----------------------------------------------------------------------------------------------------
                                                                                Energy     Emission factor       Emissions
                                                                              kWh/year          kg CO2/kWh     kg CO2/year
Efficiency of heat source Heat pump                                                                           300.0000 (367b)
Space heating from Heat pump                                                  887.6286              0.5190    460.6792 (368)
Electrical energy for heat distribution                                        26.6289              0.5190     13.8204 (372)
Total CO2 associated with community systems                                                                   474.4996 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                                       474.4996 (376)
Pumps and fans                                                                 80.7030              0.5190     41.8849 (378)
Energy for lighting                                                           251.0355              0.5190    130.2874 (379)
Total CO2, kg/year                                                                                            646.6719 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                    12.8300 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                     12.8300 ZC1
Total Floor Area                                                                                  TFA   50.4000
Assumed number of occupants                                                                         N    1.7019
CO2 emission factor in Table 12 for electricity displaced from grid                                EF    0.5190
CO2 emissions from appliances, equation (L14)                                                           17.4332 ZC2
CO2 emissions from cooking, equation (L16)                                                               3.1715 ZC3
Total CO2 emissions                                                                                     33.4347 ZC4
Residual CO2 emissions offset from biofuel CHP                                                           0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                 0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                          0.0000 ZC7
Net CO2 emissions                                                                                       33.4347 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------


----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                          Area        Storey height          Volume
                                                                          (m2)              (m)               (m3)
Ground floor                                                           50.4000 (1b)   x    2.5000 (2b)   =   126.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          50.4000                                               (4)
Dwelling volume                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   126.0000 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                  main        secondary          other           total       m3 per hour
                                               heating          heating
Number of chimneys                                   0     +          0     +        0     =        0 * 40 =     0.0000 (6a)
Number of open flues                                 0     +          0     +        0     =        0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                         2 * 10 =    20.0000 (7a)
Number of passive vents                                                                             0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                        0 * 40 =     0.0000 (7c)

                                                                                               Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                   20.0000 / (5) =     0.1587 (8)
Pressure test                                                                                                        Yes
Measured/design AP50                                                                                              5.0000
Infiltration rate                                                                                                 0.4087 (18)
Number of sides sheltered                                                                                              3 (19)

Shelter factor                                                                     (20) = 1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                      (21) = (18) x (20)  =     0.3168 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed    5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor   1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
              0.4039     0.3960     0.3880     0.3484     0.3405     0.3009     0.3009     0.2930     0.3168     0.3405     0.3564     0.3722 (22b)
Effective ac  0.5816     0.5784     0.5753     0.5607     0.5580     0.5453     0.5453     0.5429     0.5502     0.5580     0.5635     0.5693 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                        Gross     Openings      NetArea      U-value        A x U      K-value        A x K
                                                  m2           m2           m2       W/m2K          W/K       kJ/m2K         kJ/K
TER Opaque door                                                         2.1200       1.0000       2.1200                           (26)
TER Opening Type (Uw = 1.40)                                            6.9800       1.3258       9.2538                           (27)
External Wall                                18.0800       6.9800      11.1000       0.1800       1.9980                           (29a)
Wall to Stairwell                            20.0500       2.1200      17.9300       0.1800       3.2274                           (29a)
Total net area of external elements Aum(A, m2)                         38.1300                                                     (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =     16.5992                       (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                   250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                            3.6645 (36)
Total fabric heat loss                                                                                (33) + (36) =  20.2637 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m        24.1812    24.0495    23.9204    23.3142    23.2007    22.6727    22.6727    22.5749    22.8761    23.2007    23.4302    23.6701 (38)
Heat transfer coeff
             44.4449    44.3132    44.1841    43.5778    43.4644    42.9364    42.9364    42.8386    43.1398    43.4644    43.6939    43.9338 (39)
Average = Sum(39)m / 12 =                                                                                               43.5773 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP           0.8818     0.8792     0.8767     0.8646     0.8624     0.8519     0.8519     0.8500     0.8559     0.8624     0.8669     0.8717 (40)
HLP (average)                                                                                                            0.8646 (40)
Days in month
                  31         28         31         30         31         30         31         31         30         31         30         31 (41)


----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                        1.7019 (42)
Average daily hot water use (litres/day)                                                                                74.6197 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
             82.0817    79.0969    76.1121    73.1273    70.1425    67.1577    67.1577    70.1425    73.1273    76.1121    79.0969    82.0817 (44)
Energy conte 121.7248  106.4613   109.8585    95.7773    91.9006    79.3032    73.4861    84.3264    85.3335    99.4480   108.5552   117.8839 (45)
Energy content (annual)                                                                          Total = Sum(45)m =   1174.0587 (45)
Distribution loss  (46)m = 0.15 x (45)m
             18.2587    15.9692    16.4788    14.3666    13.7851    11.8955    11.0229    12.6490    12.8000    14.9172    16.2833    17.6826 (46)
Water storage loss:
Store volume                                                                                                             3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                            0.2602 (48)
  Temperature factor from Table 2b                                                                                       0.5400 (49)
Enter (49) or (54) in (55)                                                                                               0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
                 4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
                 4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss    23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
               149.3424  131.4063  137.4762  122.5041  119.5183  106.0300  101.1038  111.9440  112.0603  127.0656  135.2820  145.5016 (62)
Solar input      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                Solar input (sum of months) = Sum(63)m =    0.0000 (63)
Output from w/h
               149.3424  131.4063  137.4762  122.5041  119.5183  106.0300  101.1038  111.9440  112.0603  127.0656  135.2820  145.5016 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m = 1499.2345 (64)
Heat gains from water heating, kWh/month
                62.5676   55.3544   58.6221   53.2274   52.6511   47.7497   46.5283   50.1327   49.7548   55.1606   57.4760   61.2905 (65)
```

```
-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                    Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m           85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941   85.0941 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                14.2147   12.6253   10.2676    7.7732    5.8106    4.9055    5.3006    6.8899    9.2477   11.7420   13.7047   14.6097 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               148.2728  149.8114  145.9342  137.6800  127.2605  117.4677  110.9256  109.3869  113.2642  121.5184  131.9378  141.7306 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094   31.5094 (69)
Pumps, fans      3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753  -68.0753 (71)
Water heating gains (Table 5)
                84.0963   82.3726   78.7931   73.9269   70.7676   66.3191   62.5380   67.3826   69.1039   74.1406   79.8278   82.3798 (72)
Total internal gains
               298.1120  296.3375  286.5231  270.9084  255.3670  240.2206  230.2924  235.1877  243.1440  258.9292  276.9986  290.2484 (73)
```

```
-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                      Area      Solar flux            g                FF           Access             Gains
                                             m2        Table 6a    Specific data    Specific data        factor                 W
                                                           W/m2      or Table 6b      or Table 6c      Table 6d
-----------------------------------------------------------------------------------------------------
Southeast                                6.9800         36.7938           0.6300           0.7000        0.7700           78.4878 (77)
-----------------------------------------------------------------------------------------------------

Solar gains     78.4878  133.6938  182.9257  226.6538  253.8711  252.0353  242.9889  222.6835  198.0698  147.7601   94.0103   67.1692 (83)
Total gains    376.5998  430.0313  469.4488  497.5622  509.2381  492.2559  473.2813  457.8713  441.2138  406.6894  371.0089  357.4176 (84)
```

```
-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                               21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                    Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau             78.7492   78.9833   79.2140   80.3160   80.5256   81.5160   81.5160   81.7020   81.1316   80.5256   80.1027   79.6653
alpha            6.2499    6.2656    6.2809    6.3544    6.3684    6.4344    6.4344    6.4468    6.4088    6.3684    6.3402    6.3110
util living area
                 0.9929    0.9829    0.9577    0.8878    0.7478    0.5524    0.3985    0.4293    0.6560    0.9054    0.9824    0.9947 (86)

MIT             20.2784   20.4301   20.6253   20.8318   20.9539   20.9943   20.9994   20.9990   20.9838   20.8352   20.5229   20.2490 (87)
Th 2            20.1830   20.1852   20.1874   20.1977   20.1996   20.2086   20.2086   20.2102   20.2051   20.1996   20.1957   20.1916 (88)
util rest of house
                 0.9907    0.9780    0.9458    0.8594    0.6970    0.4867    0.3272    0.3562    0.5879    0.8751    0.9765    0.9930 (89)
MIT 2           19.2280   19.4481   19.7257   20.0114   20.1578   20.2050   20.2083   20.2098   20.1936   20.0229   19.5916   19.1922 (90)
Living area fraction                                                                          fLA = Living area / (4) =    0.5843 (91)
MIT             19.8418   20.0219   20.2513   20.4908   20.6230   20.6662   20.6706   20.6710   20.6554   20.4976   20.1358   19.8097 (92)
Temperature adjustment                                                                                                     0.0000
adjusted MIT    19.8418   20.0219   20.2513   20.4908   20.6230   20.6662   20.6706   20.6710   20.6554   20.4976   20.1358   19.8097 (93)
```

```
-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                    Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation      0.9896    0.9768    0.9469    0.8704    0.7246    0.5249    0.3689    0.3989    0.6271    0.8873    0.9760    0.9921 (94)
Useful gains   372.6862  420.0689  444.5171  433.0955  368.9784  258.4016  174.5941  182.6658  276.7012  360.8582  362.0868  354.5931 (95)
Ext temp.        4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
               690.7526  670.0989  607.5912  505.1003  387.8338  260.4609  174.7756  182.9630  282.7967  430.1914  569.5834  685.7942 (97)
Month fracti     1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
               236.6414  168.0202  121.3271   51.8434   14.0284    0.0000    0.0000    0.0000    0.0000   51.5839  149.3976  246.4136 (98)
Space heating                                                                                                           1039.2555 (98)
Space heating per m2                                                                                    (98) / (4) =   20.6201 (99)
```

```
-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
```


CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                      0.0000 (201)
Fraction of space heat from main system(s)                                                                                 1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                          93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                    0.0000 (208)
Space heating requirement                                                                                               1111.5033 (211)

                    Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
               236.6414  168.0202  121.3271   51.8434   14.0284    0.0000    0.0000    0.0000    0.0000   51.5839  149.3976  246.4136 (98)
Space heating efficiency (main heating system 1)
                93.5000   93.5000   93.5000   93.5000   93.5000    0.0000    0.0000    0.0000    0.0000   93.5000   93.5000   93.5000 (210)
Space heating fuel (main heating system)
               253.0924  179.7007  129.7616   55.4475   15.0037    0.0000    0.0000    0.0000    0.0000   55.1700  159.7835  263.5440 (211)
Water heating requirement
                 0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
               149.3424  131.4063  137.4762  122.5041  119.5183  106.0300  101.1038  111.9440  112.0603  127.0656  135.2820  145.5016 (64)
Efficiency of water heater                                                                                                79.8000 (216)
(217)m          86.0365   85.4705   84.4826   82.7078   80.8036   79.8000   79.8000   79.8000   79.8000   82.6206   85.0789   86.2085 (217)
Fuel for water heating, kWh/month
               173.5804  153.7445  162.7271  148.1168  147.9121  132.8697  126.6964  140.2808  140.4264  153.7942  159.0077  168.7787 (219)
Water heating fuel used                                                                                                 1807.9348 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                        1111.5033 (211)
Space heating fuel - secondary                                                                                             0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                   30.0000 (230c)
   main heating flue fan                                                                                                  45.0000 (230e)
Total electricity for the above, kWh/year                                                                                 75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                      251.0355 (232)
Total delivered energy for all uses                                                                                     3245.4735 (238)
```

```
-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                              Energy      Emission factor          Emissions
                                                                            kWh/year           kg CO2/kWh        kg CO2/year
Space heating - main system 1                                              1111.5033               0.2160           240.0847 (261)
Space heating - secondary                                                     0.0000               0.0000             0.0000 (263)
Water heating (other fuel)                                                 1807.9348               0.2160           390.5139 (264)
Space and water heating                                                                                             630.5986 (265)
Pumps and fans                                                               75.0000               0.5190            38.9250 (267)
Energy for lighting                                                         251.0355               0.5190           130.2874 (268)
Total CO2, kg/m2/year                                                                                               799.8110 (272)
Emissions per m2 for space and water heating                                                                         12.5119 (272a)
Fuel factor (electricity)                                                                                             1.5500
Emissions per m2 for lighting                                                                                         2.5851 (272b)
Emissions per m2 for pumps and fans                                                                                   0.7723 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5119 * 1.55) + 2.5851 + 0.7723, rounded to 2 d.p.                    22.7500 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 005 D2 - 2B3P	Issued on Date	15/12/2020
Assessment Reference	2B3P Be Clean	Prop Type Ref	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	DER	12.93	TER	22.08
Environmental	91 B	% DER<TER	41.44		
CO_2 Emissions (t/year)	0.66	DFEE	34.72	TFEE	34.94
General Requirements Compliance	Pass	% DFEE<TFEE	0.65		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	Assessor ID	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.08 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.93 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)34.7 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.31 (max. 2.00)        1.40 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                    OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                                -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                     OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.42
Maximum                                 1.5                                                     OK
MVHR efficiency:                        91%
Minimum:                                70%                                                     OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                                  OK
Based on:
Overshading:                            Average
Windows facing South East:              10.98 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------

----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                         Area        Storey height          Volume
                                                                        (m2)                  (m)             (m3)
Ground floor                                                         62.2000 (1b)   x    2.5000 (2b)   =   155.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        62.2000                                              (4)
Dwelling volume                                                   (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    155.5000 (5)

----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                      main          secondary          other            total       m3 per hour
                                                   heating            heating
Number of chimneys                                       0      +          0      +        0      =        0 * 40 =      0.0000 (6a)
Number of open flues                                     0      +          0      +        0      =        0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                    0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                               0 * 40 =      0.0000 (7c)

                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                     0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                        Yes
Measured/design AP50                                                                                              3.0000
Infiltration rate                                                                                                 0.1500 (18)
Number of sides sheltered                                                                                              3 (19)

Shelter factor                                                                        (20) = 1 - [0.075 x (19)] =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                                     (21) = (18) x (20)  =      0.1163 (21)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                        0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                     77.3500 (23c)

Effective ac    0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)

----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                        Gross       Openings       NetArea      U-value         A x U      K-value         A x K
                                                  m2             m2            m2        W/m2K           W/K       kJ/m2K          kJ/K
Window Double-Glazed (Uw = 1.40)                                          10.9800       1.3258       14.5568                            (27)
Door                                                                       2.1200       0.8200        1.7384                            (26)
External Wall                                24.6800        10.9800       13.7000       0.1800        2.4660                            (29a)
Wall to CA                                   36.7000         2.1200       34.5800       0.1671        5.7772                            (29a)
Total net area of external elements Aum(A, m2)                            61.3800                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =     24.5385                            (33)
Party Wall 1                                                              19.9500       0.0000        0.0000                            (32)
Party Floor 1                                                             62.2000                                                   (32d)
Party Ceilings 1                                                          62.2000                                                   (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                               250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                         7.8756 (36)
Total fabric heat loss                                                                        (33) + (36) =      32.4141 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          13.4173    13.2681    13.1190    12.3733    12.2242    11.4785    11.4785    11.3294    11.7768    12.2242    12.5225    12.8207 (38)
Heat transfer coeff
               45.8313    45.6822    45.5331    44.7874    44.6383    43.8926    43.8926    43.7434    44.1909    44.6383    44.9365    45.2348 (39)
Average = Sum(39)m / 12 =                                                                                                 44.7501 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.7368     0.7344     0.7320     0.7201     0.7177     0.7057     0.7057     0.7033     0.7105     0.7177     0.7225     0.7272 (40)
HLP (average)                                                                                                             0.7195 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)

----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                         2.0431 (42)
Average daily hot water use (litres/day)                                                                                 82.7237 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               90.9961    87.6872    84.3782    81.0693    77.7603    74.4514    74.4514    77.7603    81.0693    84.3782    87.6872    90.9961 (44)
Energy conte  134.9446   118.0234   121.7896   106.1791   101.8814    87.9159    81.4670    93.4846    94.6011   110.2484   120.3448   130.6866 (45)
Energy content (annual)                                                                             Total = Sum(45)m =   1301.5665 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
               20.2417    17.7035    18.2684    15.9269    15.2822    13.1874    12.2200    14.0227    14.1902    16.5373    18.0517    19.6030 (46)
Water storage loss:
Store volume                                                                                                              3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                              0.0212 (51)
  Volume factor from Table 2a                                                                                             3.4200 (52)
  Temperature factor from Table 2b                                                                                        1.0000 (53)
Enter (49) or (54) in (55)                                                                                                0.2173 (55)
Total storage loss
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              164.9423   145.1181   151.7873   135.2091   131.8791   116.9459   111.4647   123.4823   123.6311   140.2461   149.3748   160.6843 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              164.9423   145.1181   151.7873   135.2091   131.8791   116.9459   111.4647   123.4823   123.6311   140.2461   149.3748   160.6843 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1654.7651 (64)
Heat gains from water heating, kWh/month
               68.8672    60.9185    64.4932    58.5286    57.8737    52.4561    51.0859    55.0818    54.6789    60.6558    63.2387    67.4515 (65)

----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552   102.1552 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               16.3014    14.4788    11.7749     8.9144     6.6636     5.6257     6.0788     7.9014    10.6053    13.4658    15.7166    16.7545 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              178.4593   180.3112   175.6446   165.7099   153.1692   141.3827   133.5086   131.6568   136.3234   146.2580   158.7987   170.5852 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155    33.2155 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242   -81.7242 (71)
Water heating gains (Table 5)
               92.5635    90.6526    86.6844    81.2897    77.7873    72.8556    68.6639    74.0346    75.9429    81.5266    87.8315    90.6606 (72)
Total internal gains
              340.9708   339.0891   327.7505   309.5606   291.2667   273.5106   261.8979   267.2394   276.5181   294.8970   315.9934   331.6469 (73)

----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                  Area      Solar flux               g               FF          Access            Gains
                                         m2        Table 6a   Specific data    Specific data          factor                W
                                                       W/m2     or Table 6b      or Table 6c        Table 6d
----------------------------------------------------------------------------------------------------
Southeast                           10.9800         36.7938          0.4000           0.7000          0.7700          78.3914 (77)
----------------------------------------------------------------------------------------------------

Solar gains    78.3914   133.5296   182.7011   226.3755   253.5594   251.7258   242.6905   222.4101   197.8266   147.5787    93.8949    67.0867 (83)
Total gains   419.3622   472.6187   510.4515   535.9360   544.8260   525.2364   504.5884   489.6495   474.3447   442.4756   409.8882   398.7336 (84)

----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                              21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            94.2465    94.5542    94.8639    96.4433    96.7655    98.4094    98.4094    98.7449    97.7452    96.7655    96.1232    95.4894
alpha           7.2831     7.3036     7.3243     7.4296     7.4510     7.5606     7.5606     7.5830     7.5163     7.4510     7.4082     7.3660
util living area
                0.9943     0.9855     0.9610     0.8862     0.7354     0.5326     0.3826     0.4107     0.6343     0.9017     0.9844     0.9959 (86)

MIT            20.4311    20.5594    20.7226    20.8903    20.9762    20.9981    20.9999    20.9998    20.9934    20.8931    20.6379    20.4064 (87)
Th 2           20.3084    20.3105    20.3126    20.3232    20.3253    20.3358    20.3358    20.3379    20.3316    20.3253    20.3210    20.3168 (88)
util rest of house
                0.9926     0.9814     0.9504     0.8599     0.6902     0.4784     0.3249     0.3517     0.5764     0.8731     0.9793     0.9946 (89)
MIT 2          19.5493    19.7359    19.9685    20.2014    20.3037    20.3346    20.3358    20.3378    20.3269    20.2105    19.8589    19.5203 (90)
Living area fraction                                                                           fLA = Living area / (4) =      0.4879 (91)
MIT            19.9796    20.1377    20.3365    20.5375    20.6319    20.6584    20.6598    20.6608    20.6521    20.5436    20.2390    19.9527 (92)
Temperature adjustment                                                                                                    0.0000
adjusted MIT   19.9796    20.1377    20.3365    20.5375    20.6319    20.6584    20.6598    20.6608    20.6521    20.5436    20.2390    19.9527 (93)

----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9917     0.9802     0.9508     0.8687     0.7112     0.5048     0.3531     0.3805     0.6045     0.8830     0.9785     0.9938 (94)
Useful gains  415.8660   463.2708   485.3603   465.5864   387.4602   265.1504   178.1515   186.3072   286.7410   390.7268   401.0867   396.2751 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              718.6169   696.0934   630.0160   521.2142   398.7032   265.9169   178.1956   186.3833   289.5432   443.8633   590.4205   712.5690 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              225.2467   156.4568   107.6239    40.0520     8.3648     0.0000     0.0000     0.0000     0.0000    39.5336   136.3203   235.3227 (98)
Space heating                                                                                                           948.9207 (98)
Space heating per m2                                                                                     (98) / (4) =     15.2560 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
------------------------------------------------------------------------------------------------
Not applicable



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9b. Energy requirements
------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                   0.0000 (301)
Fraction of space heat from community system                                                             1.0000 (302)
Fraction of heat from community Heat pump                                                                1.0000 (303b)
Fraction of total space heat from community Heat pump                                                    1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating                        1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                        1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                        1.3000 (306)
Space heating:
Annual space heating requirement                                                                       948.9207 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                                 1233.5969 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                  0.0000 (308)
Space heating fuel for secondary/supplementary system                                                    0.0000 (309)

Water heating
Annual water heating requirement                                                                      1654.7651 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                                 2151.1946 (310b)
Electricity used for heat distribution                                                                  33.8479 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                                     99.5978 (330a)
Total electricity for the above, kWh/year                                                               99.5978 (331)
Electricity for lighting (calculated in Appendix L)                                                    287.8882 (332)
Total delivered energy for all uses                                                                   3772.2775 (338)



------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
------------------------------------------------------------------------------------------------
                                                                  Energy      Emission factor         Emissions
                                                               kWh/year           kg CO2/kWh       kg CO2/year
Efficiency of heat source Heat pump                                                                300.0000 (367b)
Space heating from Heat pump                                  1128.2639               0.5190        585.5689 (368)
Electrical energy for heat distribution                         33.8479               0.5190         17.5671 (372)
Total CO2 associated with community systems                                                         603.1360 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                              603.1360 (376)
Pumps and fans                                                  99.5978               0.5190         51.6912 (378)
Energy for lighting                                            287.8882               0.5190        149.4140 (379)
Total CO2, kg/year                                                                                   804.2412 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                           12.9300 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                   12.9300 ZC1
Total Floor Area                                                                              TFA     62.2000
Assumed number of occupants                                                                     N      2.0431
CO2 emission factor in Table 12 for electricity displaced from grid                            EF      0.5190
CO2 emissions from appliances, equation (L14)                                                         17.0018 ZC2
CO2 emissions from cooking, equation (L16)                                                             2.7015 ZC3
Total CO2 emissions                                                                                   32.6333 ZC4
Residual CO2 emissions offset from biofuel CHP                                                         0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                               0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                        0.0000 ZC7
Net CO2 emissions                                                                                     32.6333 ZC8



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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
------------------------------------------------------------------------------------------------
                                                                          Area        Storey height              Volume
                                                                          (m2)                  (m)                (m3)
Ground floor                                                          62.2000 (1b)    x      2.5000 (2b)    =  155.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        62.2000                                                  (4)
Dwelling volume                                                             (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =  155.5000 (5)



------------------------------------------------------------------------------------------------
2. Ventilation rate
------------------------------------------------------------------------------------------------
                                                   main          secondary          other            total       m3 per hour
                                                heating            heating
Number of chimneys                                    0      +           0     +        0     =        0 * 40 =      0.0000 (6a)
Number of open flues                                  0      +           0     +        0     =        0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                            2 * 10 =     20.0000 (7a)
Number of passive vents                                                                                0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                           0 * 40 =      0.0000 (7c)

                                                                                                   Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                    20.0000 / (5) =      0.1286 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                5.0000
Infiltration rate                                                                                                   0.3786 (18)
Number of sides sheltered                                                                                                3 (19)

Shelter factor                                                                        (20) = 1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                          (21) = (18) x (20)   =      0.2934 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed    5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor   1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
              0.3741     0.3668     0.3594     0.3228     0.3154     0.2788     0.2788     0.2714     0.2934     0.3154     0.3301     0.3448 (22b)
Effective ac  0.5700     0.5673     0.5646     0.5521     0.5497     0.5389     0.5389     0.5368     0.5431     0.5497     0.5545     0.5594 (25)



------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
------------------------------------------------------------------------------------------------
Element                                         Gross     Openings      NetArea      U-value        A x U      K-value        A x K
                                                   m2           m2           m2        W/m2K          W/K       kJ/m2K         kJ/K
TER Opaque door                                                          2.1200       1.0000       2.1200                           (26)
TER Opening Type (Uw = 1.40)                                            10.9800       1.3258      14.5568                           (27)
External Wall                                 24.6800      10.9800      13.7000       0.1800       2.4660                           (29a)
Wall to CA                                    36.7000       2.1200      34.5800       0.1800       6.2244                           (29a)
Total net area of external elements Aum(A, m2)                          61.3800                                                     (31)
Fabric heat loss, W/K = Sum (A x U)                           (26)...(30) + (32) =    25.3672                                       (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                       250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                5.2265 (36)
Total fabric heat loss                                                                                 (33) + (36) =     30.5937 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m        29.2487    29.1092    28.9726    28.3305    28.2104    27.6512    27.6512    27.5477    27.8666    28.2104    28.4534    28.7075 (38)
Heat transfer coeff
             59.8424    59.7030    59.5663    58.9243    58.8041    58.2449    58.2449    58.1414    58.4603    58.8041    59.0471    59.3012 (39)
Average = Sum(39)m / 12 =                                                                                                 58.9237 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP           0.9621     0.9599     0.9577     0.9473     0.9454     0.9364     0.9364     0.9347     0.9399     0.9454     0.9493     0.9534 (40)
HLP (average)                                                                                                              0.9473 (40)
Days in month
                  31         28         31         30         31         30         31         31         30         31         30         31 (41)



------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                          2.0431 (42)
Average daily hot water use (litres/day)                                                                                  82.7237 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
             90.9961    87.6872    84.3782    81.0693    77.7603    74.4514    74.4514    77.7603    81.0693    84.3782    87.6872    90.9961 (44)
Energy conte 134.9446  118.0234   121.7896   106.1791   101.8814    87.9159    81.4670    93.4846    94.6011   110.2484   120.3448   130.6866 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1301.5665 (45)
Distribution loss  (46)m = 0.15 x (45)m
             20.2417    17.7035    18.2684    15.9269    15.2822    13.1874    12.2200    14.0227    14.1902    16.5373    18.0517    19.6030 (46)
Water storage loss:
Store volume                                                                                                               3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                              0.2602 (48)
  Temperature factor from Table 2b                                                                                         0.5400 (49)
Enter (49) or (54) in (55)                                                                                                 0.1405 (55)
Total storage loss
```

```
                 4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
                 4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss    23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
               162.5623  142.9684  149.4073  132.9059  129.4991  114.6427  109.0847  121.1022  121.3279  137.8661  147.0716  158.3043 (62)
Solar input      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                   Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               162.5623  142.9684  149.4073  132.9059  129.4991  114.6427  109.0847  121.1022  121.3279  137.8661  147.0716  158.3043 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =   1626.7423 (64)
Heat gains from water heating, kWh/month
                66.9632   59.1988   62.5892   56.6860   55.9697   50.6135   49.1819   53.1778   52.8363   58.7517   61.3961   65.5474 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m          102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552  102.1552 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                16.3014   14.4788   11.7749    8.9144    6.6636    5.6257    6.0788    7.9014   10.6053   13.4658   15.7166   16.7545 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               178.4593  180.3112  175.6446  165.7099  153.1692  141.3827  133.5086  131.6568  136.3234  146.2580  158.7987  170.5852 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155   33.2155 (69)
Pumps, fans      3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242  -81.7242 (71)
Water heating gains (Table 5)
                90.0043   88.0934   84.1252   78.7305   75.2281   70.2965   66.1047   71.4755   73.3837   78.9674   85.2723   88.1014 (72)
Total internal gains
               341.4116  339.5299  328.1913  310.0014  291.7075  273.9515  262.3387  267.6803  276.9589  295.3378  316.4342  332.0877 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                      Area       Solar flux              g             FF            Access            Gains
                                             m2         Table 6a    Specific data  Specific data          factor                W
                                                            W/m2      or Table 6b    or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
Southeast                               10.9800          36.7938          0.6300         0.7000           0.7700         123.4665 (77)
-----------------------------------------------------------------------------------------------------

Solar gains    123.4665  210.3092  287.7542  356.5413  399.3560  396.4681  382.2376  350.2959  311.5769  232.4364  147.8844  105.6616 (83)
Total gains    464.8782  549.8391  615.9455  666.5428  691.0635  670.4196  644.5763  617.9761  588.5358  527.7742  464.3186  437.7493 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau             72.1803   72.3489   72.5149   73.3050   73.4548   74.1600   74.1600   74.2921   73.8868   73.4548   73.1525   72.8391
alpha            5.8120    5.8233    5.8343    5.8870    5.8970    5.9440    5.9440    5.9528    5.9258    5.8970    5.8768    5.8559
util living area
                 0.9937    0.9831    0.9557    0.8820    0.7395    0.5484    0.3966    0.4311    0.6606    0.9099    0.9844    0.9954 (86)

MIT             20.1598   20.3420   20.5696   20.8038   20.9438   20.9919   20.9990   20.9984   20.9771   20.7940   20.4301   20.1223 (87)
Th 2            20.1150   20.1169   20.1188   20.1275   20.1291   20.1367   20.1367   20.1381   20.1337   20.1291   20.1258   20.1224 (88)
util rest of house
                 0.9918    0.9781    0.9431    0.8516    0.6855    0.4778    0.3193    0.3512    0.5874    0.8793    0.9789    0.9940 (89)
MIT 2           19.0036   19.2677   19.5909   19.9117   20.0786   20.1317   20.1363   20.1374   20.1176   19.9079   19.4037   18.9547 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.4879 (91)
MIT             19.5678   19.7919   20.0684   20.3470   20.5008   20.5514   20.5572   20.5575   20.5370   20.3403   19.9045   19.5244 (92)
Temperature adjustment                                                                                                       0.0000
adjusted MIT    19.5678   19.7919   20.0684   20.3470   20.5008   20.5514   20.5572   20.5575   20.5370   20.3403   19.9045   19.5244 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation      0.9902    0.9759    0.9422    0.8598    0.7093    0.5120    0.3571    0.3903    0.6223    0.8876    0.9772    0.9928 (94)
Useful gains   460.3340  536.5619  580.3572  573.1107  490.1850  343.2866  230.1610  241.1717  366.2698  468.4276  453.7421  434.5791 (95)
Ext temp.        4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
               913.6608  889.0911  808.2212  674.5066  517.5216  346.6400  230.4891  241.7235  376.3087  572.7706  756.0681  908.7555 (97)
Month fracti     1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
               337.2751  236.8996  169.5308   73.0051   20.3384    0.0000    0.0000    0.0000    0.0000   77.6312  217.6747  352.7873 (98)
Space heating                                                                                                             1485.1423 (98)
Space heating per m2                                                                                      (98) / (4) =      23.8769 (99)


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8c. Space cooling requirement
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Not applicable


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014


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9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                       0.0000 (201)
Fraction of space heat from main system(s)                                                                                  1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                           93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                     0.0000 (208)
Space heating requirement                                                                                                1588.3875 (211)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
               337.2751  236.8996  169.5308   73.0051   20.3384    0.0000    0.0000    0.0000    0.0000   77.6312  217.6747  352.7873 (98)
Space heating efficiency (main heating system 1)
                93.5000   93.5000   93.5000   93.5000   93.5000    0.0000    0.0000    0.0000    0.0000   93.5000   93.5000   93.5000 (210)
Space heating fuel (main heating system)
               360.7221  253.3686  181.3164   78.0803   21.7523    0.0000    0.0000    0.0000    0.0000   83.0280  232.8072  377.3126 (211)
Water heating requirement
                 0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
               162.5623  142.9684  149.4073  132.9059  129.4991  114.6427  109.0847  121.1022  121.3279  137.8661  147.0716  158.3043 (64)
Efficiency of water heater                                                                                                  79.8000 (216)
(217)m          86.7183   86.1523   85.1514   83.2915   81.1016   79.8000   79.8000   79.8000   79.8000   83.3501   85.8581   86.8913 (217)
Fuel for water heating, kWh/month
               187.4601  165.9484  175.4607  159.5672  159.6752  143.6625  136.6976  151.7572  152.0399  165.4061  171.2962  182.1866 (219)
Water heating fuel used                                                                                                  1951.1576 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                         1588.3875 (211)
Space heating fuel - secondary                                                                                              0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                    30.0000 (230c)
   main heating flue fan                                                                                                   45.0000 (230e)
Total electricity for the above, kWh/year                                                                                  75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                       287.8882 (232)
Total delivered energy for all uses                                                                                      3902.4333 (238)


-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                                  Energy     Emission factor        Emissions
                                                                                kWh/year          kg CO2/kWh      kg CO2/year
Space heating - main system 1                                                  1588.3875              0.2160         343.0917 (261)
Space heating - secondary                                                         0.0000              0.0000           0.0000 (263)
Water heating (other fuel)                                                     1951.1576              0.2160         421.4500 (264)
Space and water heating                                                                                              764.5417 (265)
Pumps and fans                                                                   75.0000              0.5190          38.9250 (267)
Energy for lighting                                                             287.8882              0.5190         149.4140 (268)
Total CO2, kg/m2/year                                                                                                952.8807 (272)
Emissions per m2 for space and water heating                                                                          12.2917 (272a)
Fuel factor (electricity)                                                                                              1.5500
Emissions per m2 for lighting                                                                                          2.4022 (272b)
Emissions per m2 for pumps and fans                                                                                    0.6258 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.2917 * 1.55) + 2.4022 + 0.6258, rounded to 2 d.p.                     22.0800 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 006 E2 - 2B4P	Issued on Date	15/12/2020
Assessment Reference	2B4P Be Clean	Prop Type Ref	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	DER	13.60	TER	22.40
Environmental	90 B	% DER<TER	39.28		
CO_2 Emissions (t/year)	0.81	DFEE	40.90	TFEE	40.67
General Requirements Compliance	Fail	% DFEE<TFEE	-0.58		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	Assessor ID	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.40 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.60 kgCO□/m²OK
------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)40.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)40.9 kWh/m²/yrFail
Excess energy =0.2 kWh/m²/yr  (0.5%)
------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.34 (max. 2.00)        1.40 (max. 3.30)          OK
------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                          OK
------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                      -

Secondary heating system:               None
------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                           OK
------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                           OK
MVHR efficiency:                        91%
Minimum:                                70%                                           OK
------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Medium                                        OK
Based on:
Overshading:                            Average
Windows facing North East:              6.00 m², No overhang
Windows facing South East:              12.90 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



------------------------------------------------------------------------------------------
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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---------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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---------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
---------------------------------------------------------------------------------------------------
                                                                                       Area        Storey height              Volume
                                                                                       (m2)                  (m)                (m3)
Ground floor                                                                       75.0000 (1b)    x      2.5000 (2b)    =    187.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                75.0000                                                       (4)
Dwelling volume                                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    187.5000 (5)

---------------------------------------------------------------------------------------------------
2. Ventilation rate
---------------------------------------------------------------------------------------------------
                                                                  main          secondary              other              total        m3 per hour
                                                               heating            heating
Number of chimneys                                                   0      +           0       +          0      =           0 * 40 =      0.0000 (6a)
Number of open flues                                                 0      +           0       +          0      =           0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                                                   0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                                       0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                                  0 * 40 =      0.0000 (7c)

                                                                                                                         Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                    0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                           Yes
Measured/design AP50                                                                                                                 3.0000
Infiltration rate                                                                                                                    0.1500 (18)
Number of sides sheltered                                                                                                                 2 (19)

Shelter factor                                                                                 (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                   (21) = (18) x (20)  =      0.1275 (21)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                           0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                        77.3500 (23c)

Effective ac    0.2758     0.2726     0.2694     0.2535     0.2503     0.2344     0.2344     0.2312     0.2408     0.2503     0.2567     0.2631 (25)

---------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
---------------------------------------------------------------------------------------------------
Element                                                     Gross        Openings         NetArea        U-value          A x U        K-value          A x K
                                                               m2              m2              m2          W/m2K            W/K         kJ/m2K           kJ/K
Window Double-Glazed (Uw = 1.40)                                                          18.9000         1.3258        25.0568                                 (27)
Door                                                                                       2.1200         0.8200         1.7384                                 (26)
External Wall                                             46.0800         18.9000         27.1800         0.1800         4.8924                                 (29a)
Wall to CA                                                30.6800          2.1200         28.5600         0.1671         4.7715                                 (29a)
Total net area of external elements Aum(A, m2)                                            76.7600                                                               (31)
Fabric heat loss, W/K = Sum (A x U)                                                     (26)...(30) + (32) =        36.4591                                 (33)
Party Wall 1                                                                              20.0500         0.0000         0.0000                                 (32)
Party Floor 1                                                                             75.0000                                                               (32d)
Party Ceilings 1                                                                          75.0000                                                               (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                  250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                          10.1164 (36)
Total fabric heat loss                                                                                           (33) + (36) =      46.5755 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          17.0659    16.8687    16.6714    15.6853    15.4881    14.5020    14.5020    14.3047    14.8964    15.4881    15.8825    16.2770 (38)
Heat transfer coeff
               63.6414    63.4442    63.2470    62.2608    62.0636    61.0775    61.0775    60.8802    61.4719    62.0636    62.4580    62.8525 (39)
Average = Sum(39)m / 12 =                                                                                                          62.2115 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.8486     0.8459     0.8433     0.8301     0.8275     0.8144     0.8144     0.8117     0.8196     0.8275     0.8328     0.8380 (40)
HLP (average)                                                                                                                        0.8295 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)

---------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
---------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                    2.3612 (42)
Average daily hot water use (litres/day)                                                                                            90.2775 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               99.3053    95.6942    92.0831    88.4720    84.8609    81.2498    81.2498    84.8609    88.4720    92.0831    95.6942    99.3053 (44)
Energy conte  147.2668   128.8005   132.9106   115.8747   111.1845    95.9438    88.9060   102.0210   103.2394   120.3156   131.3339   142.6201 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =    1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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               22.0900    19.3201    19.9366    17.3812    16.6777    14.3916    13.3359    15.3031    15.4859    18.0473    19.7001    21.3930 (46)
Water storage loss:
Store volume                                                                                                                         3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                         0.0212 (51)
  Volume factor from Table 2a                                                                                                        3.4200 (52)
  Temperature factor from Table 2b                                                                                                   1.0000 (53)
Enter (49) or (54) in (55)                                                                                                           0.2173 (55)
Total storage loss
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              177.2645   155.8952   162.9083   144.9047   141.1822   124.9738   118.9037   132.0186   132.2694   150.3133   160.3639   172.6178 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                       Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              177.2645   155.8952   162.9083   144.9047   141.1822   124.9738   118.9037   132.0186   132.2694   150.3133   160.3639   172.6178 (64)
                                                                                         Total per year (kWh/year) = Sum(64)m =   1773.6154 (64)
Heat gains from water heating, kWh/month
               72.9644    64.5019    68.1909    61.7524    60.9670    55.1253    53.5594    57.9201    57.5511    64.0031    66.8925    71.4193 (65)

---------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
---------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               18.6035    16.5235    13.4378    10.1733     7.6046     6.4202     6.9372     9.0173    12.1029    15.3675    17.9361    19.1206 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              208.6751   210.8404   205.3837   193.7670   179.1030   165.3209   156.1136   153.9482   159.4049   171.0216   185.6856   199.4678 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463 (71)
Water heating gains (Table 5)
               98.0704    95.9850    91.6545    85.7672    81.9449    76.5630    71.9884    77.8496    79.9321    86.0256    92.9063    95.9937 (72)
Total internal gains
              383.7664   381.7663   368.8934   348.1248   327.0699   306.7214   293.4566   299.2324   309.8573   330.8321   354.9454   372.9994 (73)

---------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------
[Jan]                                                   Area        Solar flux               g               FF          Access            Gains
                                                          m2          Table 6a   Specific data   Specific data          factor                W
                                                                          W/m2     or Table 6b     or Table 6c        Table 6d
---------------------------------------------------------------------------------------------------
Northeast                                             6.0000           11.2829          0.4000          0.7000          0.7700          13.1361 (75)
Southeast                                            12.9000           36.7938          0.4000          0.7000          0.7700          92.0992 (77)
---------------------------------------------------------------------------------------------------

Solar gains   105.2353   183.6179   262.8236   345.0772   404.2463   409.1223   391.1919   345.8567   291.1210   206.0617   126.8422    89.5453 (83)
Total gains   489.0016   565.3842   631.7170   693.2020   731.3162   715.8437   684.6485   645.0891   600.9784   536.8939   481.7876   462.5447 (84)

---------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
---------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                         21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            81.8388    82.0932    82.3492    83.6535    83.9193    85.2742    85.2742    85.5505    84.7270    83.9193    83.3893    82.8660
alpha           6.4559     6.4729     6.4899     6.5769     6.5946     6.6849     6.6849     6.7034     6.6485     6.5946     6.5593     6.5244
util living area
                0.9964     0.9902     0.9705     0.9012     0.7474     0.5417     0.3921     0.4332     0.6838     0.9337     0.9905     0.9974 (86)

MIT            20.2374    20.3881    20.5968    20.8290    20.9593    20.9958    20.9996    20.9992    20.9824    20.8082    20.4804    20.2106 (87)
Th 2           20.2115    20.2137    20.2160    20.2273    20.2296    20.2409    20.2409    20.2432    20.2364    20.2296    20.2250    20.2205 (88)
util rest of house
                0.9953     0.9872     0.9617     0.8754     0.6979     0.4794     0.3247     0.3624     0.6168     0.9100     0.9871     0.9966 (89)
MIT 2          19.1908    19.4110    19.7110    20.0356    20.1926    20.2383    20.2407    20.2428    20.2236    20.0170    19.5551    19.1589 (90)
Living area fraction                                                                                fLA = Living area / (4) =       0.4516 (91)
MIT            19.6634    19.8523    20.1110    20.3939    20.5388    20.5804    20.5834    20.5844    20.5663    20.3743    19.9730    19.6338 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT   19.6634    19.8523    20.1110    20.3939    20.5388    20.5804    20.5834    20.5844    20.5663    20.3743    19.9730    19.6338 (93)

---------------------------------------------------------------------------------------------------
8. Space heating requirement
---------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9943     0.9855     0.9604     0.8814     0.7184     0.5075     0.3551     0.3944     0.6464     0.9150     0.9858     0.9958 (94)
Useful gains  486.1965   557.1978   606.6900   610.9998   525.3744   363.2631   243.1424   254.4442   388.4945   491.2561   474.9321   460.6086 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              977.7515   948.6336   860.8566   715.6183   548.5680   365.2659   243.2979   254.7486   397.4938   606.6294   804.0211   970.0552 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              365.7169   263.0449   189.0999    75.3253    17.2561     0.0000     0.0000     0.0000     0.0000    85.8378   236.9441   379.0283 (98)
Space heating                                                                                                                     1612.2532 (98)
Space heating per m2                                                                                              (98) / (4) =      21.4967 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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--------------------------------------------------------------------------------------------------
8c. Space cooling requirement
--------------------------------------------------------------------------------------------------
Not applicable


--------------------------------------------------------------------------------------------------
9b. Energy requirements
--------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                    0.0000 (301)
Fraction of space heat from community system                                             1.0000 (302)
Fraction of heat from community Heat pump                                                1.0000 (303b)
Fraction of total space heat from community Heat pump                                    1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating         1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating         1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                        1.3000 (306)
Space heating:
Annual space heating requirement                                                      1612.2532 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                 2095.9291 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                    0.0000 (309)

Water heating
Annual water heating requirement                                                      1773.6154 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                 2305.7001 (310b)
Electricity used for heat distribution                                                  44.0163 (313)
Annual totals kWh/year

Electricity for pumps and fans:
   (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
  mechanical ventilation fans (SFP =      0.5500)                                      125.8125 (330a)
Total electricity for the above, kWh/year                                              125.8125 (331)
Electricity for lighting (calculated in Appendix L)                                    328.5442 (332)
Total delivered energy for all uses                                                   4855.9859 (338)


--------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
--------------------------------------------------------------------------------------------------
                                                      Energy     Emission factor       Emissions
                                                    kWh/year         kg CO2/kWh      kg CO2/year
Efficiency of heat source Heat pump                                                  300.0000 (367b)
Space heating from Heat pump                       1467.2097             0.5190       761.4818 (368)
Electrical energy for heat distribution              44.0163             0.5190        22.8445 (372)
Total CO2 associated with community systems                                           784.3263 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                               784.3263 (376)
Pumps and fans                                      125.8125             0.5190        65.2967 (378)
Energy for lighting                                 328.5442             0.5190       170.5144 (379)
Total CO2, kg/year                                                                   1020.1374 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                            13.6000 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                    13.6000 ZC1
Total Floor Area                                                              TFA      75.0000
Assumed number of occupants                                                     N       2.3612
CO2 emission factor in Table 12 for electricity displaced from grid            EF       0.5190
CO2 emissions from appliances, equation (L14)                                          16.4875 ZC2
CO2 emissions from cooking, equation (L16)                                              2.3422 ZC3
Total CO2 emissions                                                                    32.4298 ZC4
Residual CO2 emissions offset from biofuel CHP                                          0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation        0.0000 ZC7
Net CO2 emissions                                                                      32.4298 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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--------------------------------------------------------------------------------------------------


--------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
--------------------------------------------------------------------------------------------------
                                                                    Area         Storey height          Volume
                                                                    (m2)              (m)                 (m3)
Ground floor                                                   75.0000 (1b)    x      2.5000 (2b)   =   187.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)       75.0000                                              (4)
Dwelling volume                                                   (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   187.5000 (5)


--------------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------------
                                              main        secondary          other          total      m3 per hour
                                            heating        heating
Number of chimneys                               0     +        0     +        0     =        0 * 40 =     0.0000 (6a)
Number of open flues                             0     +        0     +        0     =        0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                                   3 * 10 =    30.0000 (7a)
Number of passive vents                                                                       0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                                  0 * 40 =     0.0000 (7c)

                                                                                          Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =             30.0000 / (5) =     0.1600 (8)
Pressure test                                                                                                  Yes
Measured/design AP50                                                                                        5.0000
Infiltration rate                                                                                           0.4100 (18)
Number of sides sheltered                                                                                        2 (19)

Shelter factor                                                           (20) = 1 - [0.075 x (19)] =        0.8500 (20)
Infiltration rate adjusted to include shelter factor                          (21) = (18) x (20) =         0.3485 (21)


                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed     5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor    1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
               0.4443   0.4356   0.4269   0.3834   0.3746   0.3311   0.3311   0.3224   0.3485   0.3746   0.3921   0.4095 (22b)
Effective ac   0.5987   0.5949   0.5911   0.5735   0.5702   0.5548   0.5548   0.5520   0.5607   0.5702   0.5769   0.5838 (25)


--------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
--------------------------------------------------------------------------------------------------
Element                                    Gross    Openings     NetArea     U-value       A x U     K-value       A x K
                                              m2          m2          m2      W/m2K         W/K      kJ/m2K        kJ/K
TER Opaque door                                                   2.1200      1.0000      2.1200                         (26)
TER Opening Type (Uw = 1.40)                                     16.6300      1.3258     22.0473                         (27)
External Wall                            46.0800     16.6300     29.4500      0.1800      5.3010                         (29a)
Wall to CA                               30.6800      2.1200     28.5600      0.1800      5.1408                         (29a)
Total net area of external elements Aum(A, m2)                   76.7600                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                        (26)...(30) + (32) =      34.6091                             (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                              250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                       6.3975 (36)
Total fabric heat loss                                                                        (33) + (36) =     41.0066 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m         37.0457  36.8085  36.5760  35.4840  35.2797  34.3286  34.3286  34.1525  34.6949  35.2797  35.6930  36.1251 (38)
Heat transfer coeff
              78.0523  77.8151  77.5826  76.4906  76.2863  75.3352  75.3352  75.1591  75.7016  76.2863  76.6996  77.1317 (39)
Average = Sum(39)m / 12 =                                                                                       76.4897 (39)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP            1.0407   1.0375   1.0344   1.0199   1.0172   1.0045   1.0045   1.0021   1.0094   1.0172   1.0227   1.0284 (40)
HLP (average)                                                                                                    1.0199 (40)
Days in month
                   31       28       31       30       31       30       31       31       30       31       30       31 (41)


--------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
--------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                2.3612 (42)
Average daily hot water use (litres/day)                                                                        90.2775 (43)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
              99.3053  95.6942  92.0831  88.4720  84.8609  81.2498  81.2498  84.8609  88.4720  92.0831  95.6942  99.3053 (44)
Energy conte 147.2668 128.8005 132.9106 115.8747 111.1845  95.9438  88.9060 102.0210 103.2394 120.3156 131.3339 142.6201 (45)
Energy content (annual)                                                                   Total = Sum(45)m =  1420.4168 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.0900  19.3201  19.9366  17.3812  16.6777  14.3916  13.3359  15.3031  15.4859  18.0473  19.7001  21.3930 (46)
Water storage loss:
Store volume                                                                                                     3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                    0.2602 (48)
  Temperature factor from Table 2b                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                       0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
                4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
                4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              174.8845   153.7455   160.5283   142.6015   138.8022   122.6706   116.5237   129.6386   129.9662   147.9332   158.0606   170.2377 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                              Solar input (sum of months) = Sum(63)m =        0.0000 (63)
Output from w/h
              174.8845   153.7455   160.5283   142.6015   138.8022   122.6706   116.5237   129.6386   129.9662   147.9332   158.0606   170.2377 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =     1745.5926 (64)
Heat gains from water heating, kWh/month
               71.0604    62.7822    66.2869    59.9098    59.0630    53.2827    51.6554    56.0161    55.7085    62.0991    65.0499    69.5153 (65)
```

```
-----------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579   118.0579 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               18.6058    16.5255    13.4395    10.1745     7.6056     6.4210     6.9381     9.0184    12.1044    15.3693    17.9383    19.1229 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              208.6751   210.8404   205.3837   193.7670   179.1030   165.3209   156.1136   153.9482   159.4049   171.0216   185.6856   199.4678 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058    34.8058 (69)
Pumps, fans     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463   -94.4463 (71)
Water heating gains (Table 5)
               95.5112    93.4258    89.0953    83.2080    79.3857    74.0038    69.4293    75.2905    77.3730    83.4665    90.3471    93.4346 (72)
Total internal gains
              384.2095   382.2092   369.3359   348.5669   327.5117   307.1630   293.8983   299.6744   310.2997   331.2748   355.3884   373.4426 (73)
```

```
-----------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------
[Jan]                                     Area        Solar flux             g             FF           Access             Gains
                                            m2          Table 6a  Specific data  Specific data           factor                 W
                                                            W/m2    or Table 6b    or Table 6c         Table 6d
-----------------------------------------------------------------------------------------------
Northeast                               5.2800           11.2829         0.6300         0.7000           0.7700           18.2066 (75)
Southeast                              11.3500           36.7938         0.6300         0.7000           0.7700          127.6270 (77)
-----------------------------------------------------------------------------------------------

Solar gains    145.8336   254.4561   364.2211   478.2120   560.2126   566.9713   542.1223   479.2935   403.4370   285.5592   175.7764   124.0906 (83)
Total gains    530.0431   636.6653   733.5570   826.7789   887.7243   874.1343   836.0206   778.9679   713.7366   616.8341   531.1648   497.5332 (84)
```

```
-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            66.7287    66.9321    67.1327    68.0911    68.2735    69.1354    69.1354    69.2974    68.8009    68.2735    67.9056    67.5252
alpha           5.4486     5.4621     5.4755     5.5394     5.5516     5.6090     5.6090     5.6198     5.5867     5.5516     5.5270     5.5017
util living area
                0.9956     0.9877     0.9643     0.8906     0.7391     0.5426     0.3952     0.4413     0.6925     0.9319     0.9892     0.9968 (86)

MIT            20.0088    20.2023    20.4658    20.7573    20.9316    20.9899    20.9986    20.9974    20.9639    20.7195    20.3069    19.9757 (87)
Th 2           20.0496    20.0522    20.0547    20.0668    20.0691    20.0796    20.0796    20.0816    20.0755    20.0691    20.0645    20.0597 (88)
util rest of house
                0.9942     0.9838     0.9534     0.8605     0.6826     0.4685     0.3132     0.3545     0.6147     0.9057     0.9852     0.9958 (89)
MIT 2          18.7353    19.0173    19.3948    19.7988    20.0080    20.0735    20.0791    20.0806    20.0499    19.7614    19.1800    18.6946 (90)
Living area fraction                                                                   fLA = Living area / (4) =      0.4516 (91)
MIT            19.3104    19.5524    19.8785    20.2316    20.4251    20.4873    20.4943    20.4946    20.4627    20.1941    19.6889    19.2731 (92)
Temperature adjustment                                                                                                  0.0000
adjusted MIT   19.3104    19.5524    19.8785    20.2316    20.4251    20.4873    20.4943    20.4946    20.4627    20.1941    19.6889    19.2731 (93)
```

```
-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9927     0.9813     0.9510     0.8664     0.7051     0.5018     0.3503     0.3938     0.6485     0.9097     0.9831     0.9946 (94)
Useful gains  526.1658   624.7291   697.5978   716.2803   625.9183   438.6080   292.8442   306.7376   462.8481   561.1576   522.1976   494.8539 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1171.5971  1140.1794  1037.9383   866.7634   665.6029   443.5237   293.3803   307.7474   481.6630   731.8978   965.5640  1162.6172 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              480.2009   346.3826   253.2134   108.3478    29.5253     0.0000     0.0000     0.0000     0.0000   127.0307   319.2238   496.8158 (98)
Space heating                                                                                                        2160.7404 (98)
Space heating per m2                                                                                  (98) / (4) =     28.8099 (99)
```

```
-----------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------
Not applicable
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
-----------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                  0.0000 (201)
Fraction of space heat from main system(s)                                                                             1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                      93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                0.0000 (208)
Space heating requirement                                                                                           2310.9523 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
              480.2009   346.3826   253.2134   108.3478    29.5253     0.0000     0.0000     0.0000     0.0000   127.0307   319.2238   496.8158 (98)
Space heating efficiency (main heating system 1)
               93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
              513.5838   370.4627   270.8164   115.8800    31.5779     0.0000     0.0000     0.0000     0.0000   135.8618   341.4159   531.3538 (211)
Water heating requirement
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
              174.8845   153.7455   160.5283   142.6015   138.8022   122.6706   116.5237   129.6386   129.9662   147.9332   158.0606   170.2377 (64)
Efficiency of water heater                                                                                            79.8000 (216)
(217)m         87.3724    86.9173    86.0247    84.0927    81.4900    79.8000    79.8000    79.8000    79.8000    84.4107    86.6522    87.5056 (217)
Fuel for water heating, kWh/month
              200.1599   176.8871   186.6073   169.5766   170.3304   153.7225   146.0197   162.4544   162.8649   175.2542   182.4080   194.5450 (219)
Water heating fuel used                                                                                             2080.8298 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                    2310.9523 (211)
Space heating fuel - secondary                                                                                         0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                               30.0000 (230c)
   main heating flue fan                                                                                              45.0000 (230e)
Total electricity for the above, kWh/year                                                                             75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                  328.5844 (232)
Total delivered energy for all uses                                                                                 4795.3665 (238)
```

```
-----------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------
                                                                       Energy     Emission factor           Emissions
                                                                     kWh/year         kg CO2/kWh         kg CO2/year
Space heating - main system 1                                       2310.9523             0.2160            499.1657 (261)
Space heating - secondary                                              0.0000             0.0000              0.0000 (263)
Water heating (other fuel)                                          2080.8298             0.2160            449.4592 (264)
Space and water heating                                                                                     948.6249 (265)
Pumps and fans                                                        75.0000             0.5190             38.9250 (267)
Energy for lighting                                                  328.5844             0.5190            170.5353 (268)
Total CO2, kg/m2/year                                                                                      1158.0852 (272)
Emissions per m2 for space and water heating                                                                 12.6483 (272a)
Fuel factor (electricity)                                                                                     1.5500
Emissions per m2 for lighting                                                                                 2.2738 (272b)
Emissions per m2 for pumps and fans                                                                           0.5190 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.6483 * 1.55) + 2.2738 + 0.5190, rounded to 2 d.p.            22.4000 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 007 B1 - 2B4P	**Issued on Date**	15/12/2020
Assessment Reference	2B4P Be Clean	**Prop Type Ref**	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	13.51	**TER**	23.54
Environmental	90 B	**% DER<TER**	42.60		
CO_2 Emissions (t/year)	0.85	**DFEE**	42.13	**TFEE**	45.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.28		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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------------------------------------------------------------------------------------------
REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
------------------------------------------------------------------------------------------

DWELLING AS DESIGNED

Mid-floor flat, total floor area 81 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.54 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.51 kgCO□/m²OK
------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.1 kWh/m²/yrOK
------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.18 (max. 0.70)         OK
Party wall      0.00 (max. 0.20)        -                       OK
Floor           (no floor)
Roof            (no roof)
Openings        1.33 (max. 2.00)       1.40 (max. 3.30)         OK
------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                         OK
------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Community heating scheme                     -

Secondary heating system:              None
------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                        OK
Primary pipework insulated:            No primary pipework
------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                    No cylinderstat


------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                          OK
------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.42
Maximum                                1.5                                          OK
MVHR efficiency:                       91%
Minimum:                               70%                                          OK
------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):           Slight                                       OK
Based on:
Overshading:                           Average
Windows facing North East:             16.25 m², No overhang
Air change rate:                       2.00 ach
Blinds/curtains:                       None
------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                     0.00 W/m²K
Door U-value                           0.82 W/m²K
Air permeability                       3.0 m³/m²h



------------------------------------------------------------------------------------------
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE   09 Jan 2014

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-------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------


-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                   Area         Storey height              Volume
                                                                   (m2)                 (m)                  (m3)
Ground floor                                                    80.9000 (1b)    x       2.5000 (2b)    =    202.2500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              80.9000                                          (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    202.2500 (5)


-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                main          secondary            other              total       m3 per hour
                                              heating           heating
Number of chimneys                                  0      +           0      +        0       =          0 * 40 =      0.0000 (6a)
Number of open flues                                0      +           0      +        0       =          0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                               0 * 10 =      0.0000 (7a)
Number of passive vents                                                                                   0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                              0 * 40 =      0.0000 (7c)

                                                                                                    Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                      0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                3.0000
Infiltration rate                                                                                                   0.1500 (18)
Number of sides sheltered                                                                                                3 (19)

Shelter factor                                                                      (20) = 1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                       (21) = (18) x (20)  =      0.1163 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                          0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                      77.3500 (23c)

Effective ac    0.2615     0.2586     0.2557     0.2411     0.2382     0.2237     0.2237     0.2208     0.2295     0.2382     0.2440     0.2498 (25)


-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                        Gross       Openings       NetArea       U-value         A x U       K-value          A x K
                                                  m2             m2            m2        W/m2K           W/K        kJ/m2K           kJ/K
Window Double-Glazed (Uw = 1.40)                                         16.2500        1.3258       21.5436                          (27)
Door                                                                      2.1200        0.8200        1.7384                          (26)
External Wall                                39.7000        16.2500      23.4500        0.1800        4.2210                          (29a)
Wall to CA                                   41.3000         2.1200      39.1800        0.1671        6.5458                          (29a)
Total net area of external elements Aum(A, m2)                           81.0000                                                      (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =      34.0487                          (33)
Party Wall 1                                                             26.5000        0.0000        0.0000                          (32)
Party Floor 1                                                            80.9000                                                      (32d)
Party Ceilings 1                                                         80.9000                                                      (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                         10.1020 (36)
Total fabric heat loss                                                                            (33) + (36) =     44.1507 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          17.4511    17.2571    17.0631    16.0933    15.8993    14.9295    14.9295    14.7355    15.3174    15.8993    16.2873    16.6752 (38)
Heat transfer coeff
               61.6018    61.4078    61.2139    60.2440    60.0500    59.0802    59.0802    58.8862    59.4681    60.0500    60.4380    60.8259 (39)
Average = Sum(39)m / 12 =                                                                                          60.1955 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.7615     0.7591     0.7567     0.7447     0.7423     0.7303     0.7303     0.7279     0.7351     0.7423     0.7471     0.7519 (40)
HLP (average)                                                                                                       0.7441 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)


-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                   2.4797 (42)
Average daily hot water use (litres/day)                                                                           93.0933 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              102.4026    98.6788    94.9551    91.2314    87.5077    83.7839    83.7839    87.5077    91.2314    94.9551    98.6788   102.4026 (44)
Energy conte  151.8601   132.8178   137.0561   119.4888   114.6523    98.9362    91.6790   105.2030   106.4594   124.0682   135.4301   147.0684 (45)
Energy content (annual)                                                                            Total = Sum(45)m =   1464.7193 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE   09 Jan 2014


```
               22.7790    19.9227    20.5584    17.9233    17.1979    14.8404    13.7518    15.7804    15.9689    18.6102    20.3145    22.0603 (46)
Water storage loss:
Store volume                                                                                                        3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                        0.0212 (51)
  Volume factor from Table 2a                                                                                       3.4200 (52)
  Temperature factor from Table 2b                                                                                  1.0000 (53)
Enter (49) or (54) in (55)                                                                                          0.2173 (55)
Total storage loss
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (56)
If cylinder contains dedicated solar storage
                6.7353     6.0835     6.7353     6.5180     6.7353     6.5180     6.7353     6.7353     6.5180     6.7353     6.5180     6.7353 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              181.8578   159.9125   167.0537   148.5188   144.6500   127.9663   121.6767   135.2007   135.4895   154.0659   164.4602   177.0661 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              181.8578   159.9125   167.0537   148.5188   144.6500   127.9663   121.6767   135.2007   135.4895   154.0659   164.4602   177.0661 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1817.9180 (64)
Heat gains from water heating, kWh/month
               74.4916    65.8377    69.5693    62.9540    62.1201    56.1203    54.4814    58.9781    58.6218    65.2508    68.2545    72.8984 (65)


-------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               19.8602    17.6397    14.3455    10.8605     8.1183     6.8539     7.4058     9.6264    12.9205    16.4055    19.1477    20.4122 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              221.3112   223.6078   217.8206   205.5004   189.9485   175.3318   165.5669   163.2704   169.0576   181.3777   196.9297   211.5464 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886 (71)
Water heating gains (Table 5)
              100.1232    97.9727    93.5071    87.4362    83.4947    77.9449    73.2277    79.2717    81.4191    87.7027    94.7980    97.9817 (72)
Total internal gains
              401.4903   399.4159   385.8690   363.9928   341.7572   320.3263   306.3962   312.3642   323.5929   345.6817   371.0711   390.1360 (73)


-------------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------------

[Jan]                                         Area      Solar flux               g                FF           Access             Gains
                                                m2        Table 6a   Specific data     Specific data           factor                 W
                                                              W/m2     or Table 6b       or Table 6c         Table 6d
-------------------------------------------------------------------------------------------------
Northeast                                  16.2500         11.2829          0.4000            0.7000           0.7700           35.5768 (75)
-------------------------------------------------------------------------------------------------

Solar gains     35.5768    72.4176   130.4735   214.2750   288.0276   307.0679   287.2558   229.0036   158.9840    88.5001    44.7648    29.0538 (83)
Total gains    437.0671   471.8335   516.3425   578.2678   629.7849   627.3942   593.6520   541.3679   482.5770   434.1818   415.8360   419.1898 (84)


-------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            91.1995    91.4876    91.7775    93.2550    93.5562    95.0920    95.0920    95.4053    94.4717    93.5562    92.9557    92.3629
alpha           7.0800     7.0992     7.1185     7.2170     7.2371     7.3395     7.3395     7.3604     7.2981     7.2371     7.1970     7.1575
util living area
                0.9987     0.9973     0.9910     0.9543     0.8198     0.5968     0.4373     0.4988     0.7976     0.9769     0.9968     0.9990 (86)

MIT            20.2601    20.3524    20.5300    20.7780    20.9471    20.9953    20.9996    20.9990    20.9681    20.7487    20.4668    20.2451 (87)
Th 2           20.2869    20.2890    20.2911    20.3015    20.3036    20.3142    20.3142    20.3163    20.3099    20.3036    20.2994    20.2952 (88)
util rest of house
                0.9982     0.9964     0.9880     0.9397     0.7766     0.5354     0.3695     0.4255     0.7367     0.9667     0.9956     0.9987 (89)
MIT 2          19.2832    19.4196    19.6793    20.0381    20.2531    20.3111    20.3140    20.3158    20.2846    20.0043    19.5953    19.2680 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.4405 (91)
MIT            19.7135    19.8305    20.0540    20.3641    20.5588    20.6125    20.6160    20.6168    20.5857    20.3323    19.9792    19.6984 (92)
Temperature adjustment                                                                                               0.0000
adjusted MIT   19.7135    19.8305    20.0540    20.3641    20.5588    20.6125    20.6160    20.6168    20.5857    20.3323    19.9792    19.6984 (93)


-------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9978     0.9956     0.9868     0.9412     0.7932     0.5624     0.3994     0.4579     0.7622     0.9672     0.9949     0.9983 (94)
Useful gains  436.0945   469.7744   509.5330   544.2415   499.5426   352.8315   237.0969   247.8751   367.8201   419.9575   413.6977   418.4846 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              949.5020   916.8524   829.6949   690.6419   531.9730   355.2218   237.2670   248.3092   385.6910   584.4231   778.3941   942.7066 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              381.9751   300.4365   238.2005   105.4083    24.1282     0.0000     0.0000     0.0000     0.0000   122.3625   262.5814   390.0212 (98)
Space heating                                                                                                    1825.1136 (98)
Space heating per m2                                                                              (98) / (4) =     22.5601 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                  0.0000 (301)
Fraction of space heat from community system                                           1.0000 (302)
Fraction of heat from community Heat pump                                              1.0000 (303b)
Fraction of total space heat from community Heat pump                                  1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating       1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating       1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                      1.3000 (306)
Space heating:
Annual space heating requirement                                                    1825.1136 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                               2372.6477 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                  0.0000 (309)

Water heating
Annual water heating requirement                                                    1817.9180 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                               2363.2934 (310b)
Electricity used for heat distribution                                                47.3594 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
   mechanical ventilation fans (SFP =       0.5250)                                  129.5411 (330a)
Total electricity for the above, kWh/year                                            129.5411 (331)
Electricity for lighting (calculated in Appendix L)                                  350.7375 (332)
Total delivered energy for all uses                                                 5216.2197 (338)


-----------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------
                                                          Energy    Emission factor      Emissions
                                                        kWh/year        kg CO2/kWh     kg CO2/year
Efficiency of heat source Heat pump                                                   300.0000 (367b)
Space heating from Heat pump                            1578.6470          0.5190      819.3178 (368)
Electrical energy for heat distribution                   47.3594          0.5190       24.5795 (372)
Total CO2 associated with community systems                                          843.8973 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                               843.8973 (376)
Pumps and fans                                           129.5411          0.5190       67.2318 (378)
Energy for lighting                                      350.7375          0.5190      182.0328 (379)
Total CO2, kg/year                                                                   1093.1620 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                            13.5100 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                    13.5100 ZC1
Total Floor Area                                                               TFA     80.9000
Assumed number of occupants                                                      N      2.4797
CO2 emission factor in Table 12 for electricity displaced from grid             EF      0.5190
CO2 emissions from appliances, equation (L14)                                          16.2107 ZC2
CO2 emissions from cooking, equation (L16)                                              2.2066 ZC3
Total CO2 emissions                                                                    31.9273 ZC4
Residual CO2 emissions offset from biofuel CHP                                          0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation         0.0000 ZC7
Net CO2 emissions                                                                      31.9273 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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-----------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------
                                                                    Area        Storey height            Volume
                                                                    (m2)                 (m)              (m3)
Ground floor                                                   80.9000 (1b)    x      2.5000 (2b)    =   202.2500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          80.9000                                           (4)
Dwelling volume                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   202.2500 (5)


-----------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------
                                              main         secondary            other              total       m3 per hour
                                           heating           heating
Number of chimneys                               0     +           0      +         0      =         0 * 40 =      0.0000 (6a)
Number of open flues                             0     +           0      +         0      =         0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                          3 * 10 =     30.0000 (7a)
Number of passive vents                                                                              0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                         0 * 40 =      0.0000 (7c)

                                                                                                 Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =               30.0000 / (5) =      0.1483 (8)
Pressure test                                                                                                Yes
Measured/design AP50                                                                                      5.0000
Infiltration rate                                                                                         0.3983 (18)
Number of sides sheltered                                                                                      3 (19)

Shelter factor                                                          (20) = 1  -  [0.075 x (19)]  =     0.7750 (20)
Infiltration rate adjusted to include shelter factor                              (21) = (18) x (20)  =     0.3087 (21)

               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed     5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor    1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
               0.3936     0.3859     0.3782     0.3396     0.3319     0.2933     0.2933     0.2856     0.3087     0.3319     0.3473     0.3627 (22b)
Effective ac   0.5775     0.5745     0.5715     0.5577     0.5551     0.5430     0.5430     0.5408     0.5476     0.5551     0.5603     0.5658 (25)


-----------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------
Element                                      Gross     Openings      NetArea      U-value        A x U      K-value       A x K
                                                m2           m2           m2        W/m2K          W/K       kJ/m2K        kJ/K
TER Opaque door                                                       2.1200       1.0000       2.1200                         (26)
TER Opening Type (Uw = 1.40)                                         16.2500       1.3258      21.5436                         (27)
External Wall                              39.7000      16.2500      23.4500       0.1800       4.2210                         (29a)
Wall to CA                                 41.3000       2.1200      39.1800       0.1800       7.0524                         (29a)
Total net area of external elements Aum(A, m2)                       81.0000                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                                    (26)...(30) + (32) =     34.9370                         (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                              250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                        6.7965 (36)
Total fabric heat loss                                                                           (33) + (36) =    41.7335 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m        38.5412    38.3404    38.1437    37.2194    37.0465    36.2414    36.2414    36.0924    36.5515    37.0465    37.3963    37.7620 (38)
Heat transfer coeff
             80.2746    80.0739    79.8771    78.9528    78.7799    77.9749    77.9749    77.8258    78.2850    78.7799    79.1297    79.4955 (39)
Average = Sum(39)m / 12 =                                                                                                  78.9520 (39)

               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP           0.9923     0.9898     0.9874     0.9759     0.9738     0.9638     0.9638     0.9620     0.9677     0.9738     0.9781     0.9826 (40)
HLP (average)                                                                                                               0.9759 (40)
Days in month
                  31         28         31         30         31         30         31         31         30         31         30         31 (41)


-----------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                           2.4797 (42)
Average daily hot water use (litres/day)                                                                                   93.0933 (43)

               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
            102.4026    98.6788    94.9551    91.2314    87.5077    83.7839    83.7839    87.5077    91.2314    94.9551    98.6788   102.4026 (44)
Energy conte 151.8601  132.8178   137.0561   119.4888   114.6523    98.9362    91.6790   105.2030   106.4594   124.0682   135.4301   147.0684 (45)
Energy content (annual)                                                                                Total = Sum(45)m =  1464.7193 (45)
Distribution loss  (46)m = 0.15 x (45)m
             22.7790    19.9227    20.5584    17.9233    17.1979    14.8404    13.7518    15.7804    15.9689    18.6102    20.3145    22.0603 (46)
Water storage loss:
Store volume                                                                                                                3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                               0.2602 (48)
  Temperature factor from Table 2b                                                                                          0.5400 (49)
Enter (49) or (54) in (55)                                                                                                  0.1405 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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               4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (56)
If cylinder contains dedicated solar storage
               4.3553     3.9338     4.3553     4.2148     4.3553     4.2148     4.3553     4.3553     4.2148     4.3553     4.2148     4.3553 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                            Solar input (sum of months) = Sum(63)m =         0.0000 (63)
Output from w/h
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (64)
                                                                              Total per year (kWh/year) = Sum(64)m =      1789.8952 (64)
Heat gains from water heating, kWh/month
              72.5876    64.1179    67.6653    61.1114    60.2160    54.2777    52.5774    57.0741    56.7792    63.3468    66.4119    70.9944 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858   123.9858 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.8602    17.6397    14.3455    10.8605     8.1183     6.8539     7.4058     9.6264    12.9205    16.4055    19.1477    20.4122 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             221.3112   223.6078   217.8206   205.5004   189.9485   175.3318   165.5669   163.2704   169.0576   181.3777   196.9297   211.5464 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986    35.3986 (69)
Pumps, fans    3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886   -99.1886 (71)
Water heating gains (Table 5)
              97.5640    95.4136    90.9480    84.8770    80.9355    75.3857    70.6685    76.7125    78.8600    85.1436    92.2388    95.4225 (72)
Total internal gains
             401.9312   399.8567   386.3098   364.4337   342.1981   320.7671   306.8371   312.8051   324.0338   346.1226   371.5120   390.5769 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                  Area         Solar flux                g               FF             Access               Gains
                                         m2           Table 6a     Specific data     Specific data          factor                   W
                                                          W/m2       or Table 6b       or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                           16.2500            11.2829            0.6300            0.7000            0.7700             56.0335 (75)
-----------------------------------------------------------------------------------------------------

Solar gains    56.0335   114.0577   205.4958   337.4831   453.6435   483.6320   452.4278   360.6807   250.3998   139.3876    70.5046    45.7598 (83)
Total gains   457.9646   513.9145   591.8056   701.9168   795.8416   804.3991   759.2649   673.4858   574.4336   485.5102   442.0166   436.3366 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           69.9854    70.1609    70.3337    71.1571    71.3133    72.0495    72.0495    72.1875    71.7642    71.3133    70.9980    70.6714
alpha          5.6657     5.6774     5.6889     5.7438     5.7542     5.8033     5.8033     5.8125     5.7843     5.7542     5.7332     5.7114
util living area
               0.9985     0.9967     0.9892     0.9484     0.8145     0.6050     0.4494     0.5252     0.8251     0.9793     0.9968     0.9989 (86)

MIT           19.9442    20.0709    20.3147    20.6527    20.8987    20.9852    20.9977    20.9948    20.9205    20.5876    20.2099    19.9227 (87)
Th 2          20.0898    20.0919    20.0939    20.1034    20.1052    20.1136    20.1136    20.1151    20.1104    20.1052    20.1016    20.0978 (88)
util rest of house
               0.9980     0.9957     0.9853     0.9307     0.7638     0.5278     0.3602     0.4275     0.7561     0.9693     0.9955     0.9985 (89)
MIT 2         18.6710    18.8575    19.2130    19.6974    20.0099    20.1042    20.1127    20.1130    20.0467    19.6165    19.0681    18.6455 (90)
Living area fraction                                                                            fLA = Living area / (4) =     0.4405 (91)
MIT           19.2319    19.3921    19.6984    20.1183    20.4015    20.4923    20.5026    20.5015    20.4317    20.0443    19.5711    19.2082 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT  19.2319    19.3921    19.6984    20.1183    20.4015    20.4923    20.5026    20.5015    20.4317    20.0443    19.5711    19.2082 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9973     0.9945     0.9832     0.9311     0.7817     0.5615     0.3996     0.4707     0.7832     0.9684     0.9945     0.9980 (94)
Useful gains 456.7484   511.0930   581.8757   653.5401   622.0975   451.6392   303.4001   316.9972   449.8712   470.1873   439.5640   435.4503 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1198.6538  1160.4357  1054.2477   885.7139   685.5003   459.4499   304.3066   319.2000   495.6754   744.0221   986.8368  1193.0819 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             551.9776   436.3583   351.4448   167.1651    47.1717     0.0000     0.0000     0.0000     0.0000   203.7331   394.0364   563.6779 (98)
Space heating                                                                                                               2715.5650 (98)
Space heating per m2                                                                                         (98) / (4) =     33.5669 (99)


-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                         0.0000 (201)
Fraction of space heat from main system(s)                                                                                    1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                             93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                       0.0000 (208)
Space heating requirement                                                                                                  2904.3476 (211)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
             551.9776   436.3583   351.4448   167.1651    47.1717     0.0000     0.0000     0.0000     0.0000   203.7331   394.0364   563.6779 (98)
Space heating efficiency (main heating system 1)
              93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
             590.3504   466.6934   375.8768   178.7862    50.4510     0.0000     0.0000     0.0000     0.0000   217.8964   421.4293   602.8641 (211)
Water heating requirement
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
             179.4777   157.7628   164.6737   146.2156   142.2700   125.6630   119.2967   132.8206   133.1862   151.6859   162.1569   174.6860 (64)
Efficiency of water heater                                                                                                   79.8000 (216)
(217)m        87.6173    87.3885    86.7871    85.1716    82.2206    79.8000    79.8000    79.8000    79.8000    85.6015    87.0953    87.7174 (217)
Fuel for water heating, kWh/month
             204.8427   180.5303   189.7444   171.6717   173.0345   157.4725   149.4946   166.4419   166.9000   177.2001   186.1834   199.1464 (219)
Water heating fuel used                                                                                                    2122.6626 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                           2904.3476 (211)
Space heating fuel - secondary                                                                                                0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                      30.0000 (230c)
   main heating flue fan                                                                                                     45.0000 (230e)
Total electricity for the above, kWh/year                                                                                    75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                         350.7375 (232)
Total delivered energy for all uses                                                                                        5452.7477 (238)


-----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                               Energy     Emission factor          Emissions
                                                                             kWh/year          kg CO2/kWh        kg CO2/year
Space heating - main system 1                                               2904.3476              0.2160           627.3391 (261)
Space heating - secondary                                                      0.0000              0.0000             0.0000 (263)
Water heating (other fuel)                                                  2122.6626              0.2160           458.4951 (264)
Space and water heating                                                                                             1085.8342 (265)
Pumps and fans                                                                75.0000              0.5190            38.9250 (267)
Energy for lighting                                                          350.7375              0.5190           182.0328 (268)
Total CO2, kg/m2/year                                                                                               1306.7920 (272)
Emissions per m2 for space and water heating                                                                          13.4219 (272a)
Fuel factor (electricity)                                                                                              1.5500
Emissions per m2 for lighting                                                                                          2.2501 (272b)
Emissions per m2 for pumps and fans                                                                                    0.4811 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.4219 * 1.55) + 2.2501 + 0.4811, rounded to 2 d.p.                    23.5400 (273)
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 008 A2 - 2B4P	Issued on Date	15/12/2020
Assessment Reference	2B4P Be Clean	Prop Type Ref	Middle floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	DER	11.74	TER	19.63
Environmental	91 B	% DER<TER	40.18		
CO_2 Emissions (t/year)	0.74	DFEE	32.53	TFEE	31.97
General Requirements Compliance	Fail	% DFEE<TFEE	-1.75		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	Assessor ID	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 77 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 19.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.74 kgCO□/m²OK
-----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)32.5 kWh/m²/yrFail
Excess energy =0.5 kWh/m²/yr  (1.6%)
-----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.18 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.34 (max. 2.00)        1.40 (max. 3.30)          OK
-----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
-----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
-----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
-----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


-----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
-----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                               OK
MVHR efficiency:                        91%
Minimum:                                70%                                               OK
-----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Medium                                            OK
Based on:
Overshading:                            Average
Windows facing South:                   8.10 m², No overhang
Windows facing South West:              10.13 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
-----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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-------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------
                                                                   Area        Storey height          Volume
                                                                   (m2)              (m)               (m3)
Ground floor                                                    76.8000 (1b)    x     2.5000 (2b)    =   192.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)         76.8000                                        (4)
Dwelling volume                                                      (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   192.0000 (5)

-------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------
                                            main        secondary          other          total       m3 per hour
                                           heating       heating
Number of chimneys                            0      +       0      +        0     =       0 * 40 =      0.0000 (6a)
Number of open flues                          0      +       0      +        0     =       0 * 20 =      0.0000 (6b)
Number of intermittent fans                                                                0 * 10 =      0.0000 (7a)
Number of passive vents                                                                    0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                               0 * 40 =      0.0000 (7c)

                                                                                         Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =             0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                  Yes
Measured/design AP50                                                                                        3.0000
Infiltration rate                                                                                           0.1500 (18)
Number of sides sheltered                                                                                        2 (19)

Shelter factor                                                          (20) =  1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                          (21) = (18) x (20)  =      0.1275 (21)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed     5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor    1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
               0.1626    0.1594    0.1562    0.1403    0.1371    0.1211    0.1211    0.1179    0.1275    0.1371    0.1434    0.1498 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                77.3500 (23c)

Effective ac   0.2758    0.2726    0.2694    0.2535    0.2503    0.2344    0.2344    0.2312    0.2408    0.2503    0.2567    0.2631 (25)

-------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------
Element                                        Gross     Openings      NetArea     U-value       A x U      K-value        A x K
                                                  m2           m2           m2      W/m2K          W/K       kJ/m2K         kJ/K
Window Double-Glazed (Uw = 1.40)                                       18.2300      1.3258     24.1686                          (27)
Door                                                                    2.1200      0.8200      1.7384                          (26)
External Wall                                40.0000      18.2300      21.7700      0.1800      3.9186                          (29a)
Wall to CA                                   12.8000       2.1200      10.6800      0.1671      1.7843                          (29a)
Total net area of external elements Aum(A, m2)                         52.8000                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                (26)...(30) + (32) =        31.6099                          (33)
Party Wall 1                                                           36.7500      0.0000      0.0000                          (32)
Party Floor 1                                                          76.8000                                                  (32d)
Party Ceilings 1                                                       76.8000                                                  (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                            250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                     8.0106 (36)
Total fabric heat loss                                                                       (33) + (36) =    39.6205 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m         17.4755   17.2735   17.0716   16.0618   15.8598   14.8500   14.8500   14.6480   15.2539   15.8598   16.2637   16.6676 (38)
Heat transfer coeff
              57.0959   56.8940   56.6920   55.6822   55.4803   54.4705   54.4705   54.2685   54.8744   55.4803   55.8842   56.2881 (39)
Average = Sum(39)m / 12 =                                                                                     55.6317 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.7434    0.7408    0.7382    0.7250    0.7224    0.7093    0.7093    0.7066    0.7145    0.7224    0.7277    0.7329 (40)
HLP (average)                                                                                                  0.7244 (40)
Days in month
                   31        28        31        30        31        30        31        31        30        31        30        31 (41)

-------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------
Assumed occupancy                                                                                             2.3993 (42)
Average daily hot water use (litres/day)                                                                     91.1843 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             100.3028   96.6554   93.0080   89.3606   85.7133   82.0659   82.0659   85.7133   89.3606   93.0080   96.6554  100.3028 (44)
Energy conte 148.7461  130.0943  134.2456  117.0386  112.3013   96.9075   89.7991  103.0457  104.2764  121.5241  132.6531  144.0527 (45)
Energy content (annual)                                                                   Total = Sum(45)m =   1434.6845 (45)
Distribution loss  (46)m = 0.15 x (45)m
```


FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


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              22.3119   19.5141   20.1368   17.5558   16.8452   14.5361   13.4699   15.4569   15.6415   18.2286   19.8980   21.6079 (46)
Water storage loss:
Store volume                                                                                                  3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                  0.0212 (51)
  Volume factor from Table 2a                                                                                 3.4200 (52)
  Temperature factor from Table 2b                                                                            1.0000 (53)
Enter (49) or (54) in (55)                                                                                    0.2173 (55)
Total storage loss
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (56)
If cylinder contains dedicated solar storage
               6.7353    6.0835    6.7353    6.5180    6.7353    6.5180    6.7353    6.7353    6.5180    6.7353    6.5180    6.7353 (57)
Primary loss  23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
             178.7438  157.1890  164.2433  146.0686  142.2990  125.9375  119.7967  133.0434  133.3064  151.5218  161.6831  174.0503 (62)
Solar input    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                         Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
             178.7438  157.1890  164.2433  146.0686  142.2990  125.9375  119.7967  133.0434  133.3064  151.5218  161.6831  174.0503 (64)
                                                                          Total per year (kWh/year) = Sum(64)m =   1787.8832 (64)
Heat gains from water heating, kWh/month
              73.4562   64.9321   68.6348   62.1394   61.3383   55.4458   53.8563   58.2609   57.8959   64.4049   67.3312   71.8957 (65)

-------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m        119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              18.9555   16.8361   13.6920   10.3657    7.7485    6.5416    7.0685    9.1878   12.3319   15.6582   18.2754   19.4823 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             212.6229  214.8293  209.2693  197.4328  182.4914  168.4485  159.0670  156.8607  162.4206  174.2571  189.1986  203.2414 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967 (69)
Pumps, fans    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736 (71)
Water heating gains (Table 5)
              98.7315   96.6252   92.2511   86.3047   82.4440   77.0080   72.3876   78.3076   80.4110   86.5658   93.5155   96.6340 (72)
Total internal gains
             389.3000  387.2806  374.2026  353.0933  331.6740  310.9883  297.5131  303.3462  314.1537  335.4712  359.9796  378.3478 (73)

-------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------
[Jan]                                 Area       Solar flux            g             FF          Access          Gains
                                        m2        Table 6a   Specific data  Specific data        factor              W
                                                      W/m2     or Table 6b    or Table 6c      Table 6d
-------------------------------------------------------------------------------------------
South                                8.1000        46.7521          0.4000         0.7000        0.7700        73.4813 (78)
Southwest                           10.1300        36.7938          0.4000         0.7000        0.7700        72.3229 (79)
-------------------------------------------------------------------------------------------

Solar gains  145.8042  243.5361  321.8538  382.1090  414.4761  405.9894  393.6679  370.0578  342.6482  265.9559  173.7266  125.3880 (83)
Total gains  535.1042  630.8167  696.0564  735.2023  746.1501  716.9777  691.1811  673.4040  656.8019  601.4270  533.7062  503.7357 (84)

-------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           93.4100   93.7416   94.0756   95.7816   96.1303   97.9124   97.9124   98.2768   97.1917   96.1303   95.4355   94.7506
alpha          7.2273    7.2494    7.2717    7.3854    7.4087    7.5275    7.5275    7.5518    7.4794    7.4087    7.3624    7.3167
util living area
               0.9932    0.9782    0.9388    0.8390    0.6770    0.4851    0.3467    0.3706    0.5725    0.8620    0.9794    0.9953 (86)

MIT           20.4426   20.6050   20.7772   20.9245   20.9856   20.9990   20.9999   20.9999   20.9965   20.9223   20.6634   20.4121 (87)
Th 2          20.3026   20.3049   20.3072   20.3188   20.3211   20.3327   20.3327   20.3350   20.3280   20.3211   20.3165   20.3118 (88)
util rest of house
               0.9912    0.9723    0.9241    0.8080    0.6323    0.4351    0.2941    0.3171    0.5184    0.8279    0.9728    0.9939 (89)
MIT 2         19.5612   19.7958   20.0370   20.2377   20.3084   20.3320   20.3326   20.3349   20.3256   20.2407   19.8908   19.5245 (90)
Living area fraction                                                                  fLA = Living area / (4) =      0.4583 (91)
MIT           19.9652   20.1667   20.3763   20.5525   20.6188   20.6377   20.6385   20.6397   20.6331   20.5531   20.2449   19.9313 (92)
Temperature adjustment                                                                                        0.0000
adjusted MIT  19.9652   20.1667   20.3763   20.5525   20.6188   20.6377   20.6385   20.6397   20.6331   20.5531   20.2449   19.9313 (93)

-------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9900    0.9710    0.9257    0.8191    0.6522    0.4580    0.3182    0.3416    0.5431    0.8402    0.9720    0.9930 (94)
Useful gains 529.7792  612.5171  644.3329  602.1931  486.6093  328.3710  219.9508  230.0369  356.7317  505.3380  518.7837  500.2009 (95)
Ext temp.      4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
             894.4200  868.5809  786.6730  648.8366  494.8177  328.8758  219.9779  230.0825  358.5002  552.2015  734.5917  885.4835 (97)
Month fracti   1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
             271.2928  172.0749  105.9011   33.5833    6.1070    0.0000    0.0000    0.0000    0.0000   34.8664  155.3817  286.6503 (98)
Space heating                                                                                              1065.8575 (98)
Space heating per m2                                                                         (98) / (4) =     13.8784 (99)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                    0.0000 (301)
Fraction of space heat from community system                                             1.0000 (302)
Fraction of heat from community Heat pump                                                1.0000 (303b)
Fraction of total space heat from community Heat pump                                    1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating         1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating         1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                        1.3000 (306)
Space heating:
Annual space heating requirement                                                      1065.8575 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                 1385.6147 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)  0.0000 (308)
Space heating fuel for secondary/supplementary system                                    0.0000 (309)

Water heating
Annual water heating requirement                                                      1787.8832 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                 2324.2481 (310b)
Electricity used for heat distribution                                                  37.0986 (313)
Annual totals kWh/year

Electricity for pumps and fans:
   (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
  mechanical ventilation fans (SFP =      0.5500)                                      128.8320 (330a)
Total electricity for the above, kWh/year                                              128.8320 (331)
Electricity for lighting (calculated in Appendix L)                                    334.7598 (332)
Total delivered energy for all uses                                                   4173.4547 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                     Energy    Emission factor         Emissions
                                                   kWh/year        kg CO2/kWh        kg CO2/year
Efficiency of heat source Heat pump                                                 300.0000 (367b)
Space heating from Heat pump                      1236.6210            0.5190       641.8063 (368)
Electrical energy for heat distribution             37.0986            0.5190        19.2542 (372)
Total CO2 associated with community systems                                         661.0605 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                             661.0605 (376)
Pumps and fans                                     128.8320            0.5190        66.8638 (378)
Energy for lighting                                334.7598            0.5190       173.7403 (379)
Total CO2, kg/year                                                                  901.6646 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                          11.7400 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                  11.7400 ZC1
Total Floor Area                                                            TFA      76.8000
Assumed number of occupants                                                   N       2.3993
CO2 emission factor in Table 12 for electricity displaced from grid          EF       0.5190
CO2 emissions from appliances, equation (L14)                                        16.4057 ZC2
CO2 emissions from cooking, equation (L16)                                            2.2993 ZC3
Total CO2 emissions                                                                  30.4450 ZC4
Residual CO2 emissions offset from biofuel CHP                                        0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                              0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation       0.0000 ZC7
Net CO2 emissions                                                                    30.4450 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                  Area       Storey height          Volume
                                                                  (m2)                (m)            (m3)
Ground floor                                                 76.8000 (1b)   x     2.5000 (2b)   =   192.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)       76.8000                                          (4)
Dwelling volume                                                  (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   192.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                          main        secondary         other          total     m3 per hour
                                       heating          heating
Number of chimneys                           0     +          0    +        0    =       0 * 40 =     0.0000 (6a)
Number of open flues                         0     +          0    +        0    =       0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                              3 * 10 =    30.0000 (7a)
Number of passive vents                                                                  0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                             0 * 40 =     0.0000 (7c)

                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =        30.0000 / (5) =    0.1563 (8)
Pressure test                                                                                          Yes
Measured/design AP50                                                                                5.0000
Infiltration rate                                                                                   0.4063 (18)
Number of sides sheltered                                                                                2 (19)

Shelter factor                                                    (20) = 1  -  [0.075 x (19)]  =    0.8500 (20)
Infiltration rate adjusted to include shelter factor                    (21) = (18) x (20)  =    0.3453 (21)


                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed    5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor   1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
              0.4403   0.4316   0.4230   0.3798   0.3712   0.3280   0.3280   0.3194   0.3453   0.3712   0.3885   0.4057 (22b)
Effective ac  0.5969   0.5932   0.5895   0.5721   0.5689   0.5538   0.5538   0.5510   0.5596   0.5689   0.5755   0.5823 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                              Gross     Openings      NetArea      U-value        A x U      K-value        A x K
                                        m2           m2           m2        W/m2K          W/K       kJ/m2K         kJ/K
TER Opaque door                                               2.1200       1.0000       2.1200                         (26)
TER Opening Type (Uw = 1.40)                                 17.0600       1.3258      22.6174                         (27)
External Wall                      40.0000      17.0600      22.9400       0.1800       4.1292                         (29a)
Wall to CA                         12.8000       2.1200      10.6800       0.1800       1.9224                         (29a)
Total net area of external elements Aum(A, m2)               52.8000                                                   (31)
Fabric heat loss, W/K = Sum (A x U)                          (26)...(30) + (32) =      30.7890                         (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                         250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                  5.5713 (36)
Total fabric heat loss                                                                   (33) + (36) =     36.3603 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m        37.8209  37.5824  37.3487  36.2508  36.0454  35.0892  35.0892  34.9122  35.4575  36.0454  36.4610  36.8954 (38)
Heat transfer coeff
             74.1812  73.9427  73.7090  72.6112  72.4058  71.4496  71.4496  71.2725  71.8179  72.4058  72.8213  73.2557 (39)
Average = Sum(39)m / 12 =                                                                                    72.6102 (39)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP           0.9659   0.9628   0.9598   0.9455   0.9428   0.9303   0.9303   0.9280   0.9351   0.9428   0.9482   0.9539 (40)
HLP (average)                                                                                                 0.9454 (40)
Days in month
                  31       28       31       30       31       30       31       31       30       31       30       31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                            2.3993 (42)
Average daily hot water use (litres/day)                                                                    91.1843 (43)

                 Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
            100.3028  96.6554  93.0080  89.3606  85.7133  82.0659  82.0659  85.7133  89.3606  93.0080  96.6554 100.3028 (44)
Energy conte 148.7461 130.0943 134.2456 117.0386 112.3013 96.9075 89.7991 103.0457 104.2764 121.5241 132.6531 144.0527 (45)
Energy content (annual)                                                              Total = Sum(45)m =   1434.6845 (45)
Distribution loss  (46)m = 0.15 x (45)m
             22.3119  19.5141  20.1368  17.5558  16.8452  14.5361  13.4699  15.4569  15.6415  18.2286  19.8980  21.6079 (46)
Water storage loss:
Store volume                                                                                                 3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                0.2602 (48)
  Temperature factor from Table 2b                                                                           0.5400 (49)
Enter (49) or (54) in (55)                                                                                   0.1405 (55)
Total storage loss
```

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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                4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (56)
If cylinder contains dedicated solar storage
                4.3553    3.9338    4.3553    4.2148    4.3553    4.2148    4.3553    4.3553    4.2148    4.3553    4.2148    4.3553 (57)
Primary loss   23.2624   21.0112   23.2624   22.5120   23.2624   22.5120   23.2624   23.2624   22.5120   23.2624   22.5120   23.2624 (59)
Total heat required for water heating calculated for each month
              176.3638  155.0393  161.8633  143.7654  139.9190  123.6343  117.4167  130.6634  131.0032  149.1418  159.3799  171.6703 (62)
Solar input     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                          Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
              176.3638  155.0393  161.8633  143.7654  139.9190  123.6343  117.4167  130.6634  131.0032  149.1418  159.3799  171.6703 (64)
                                                                           Total per year (kWh/year) = Sum(64)m =  1759.8604 (64)
Heat gains from water heating, kWh/month
               71.5522   63.2123   66.7308   60.2968   59.4343   53.6032   51.9523   56.3568   56.0533   62.5009   65.4886   69.9916 (65)
```

```
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(66)m         119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670  119.9670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               18.9570   16.8374   13.6931   10.3666    7.7491    6.5421    7.0690    9.1886   12.3329   15.6594   18.2769   19.4839 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              212.6229  214.8293  209.2693  197.4328  182.4914  168.4485  159.0670  156.8607  162.4206  174.2571  189.1986  203.2414 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967   34.9967 (69)
Pumps, fans     3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736  -95.9736 (71)
Water heating gains (Table 5)
               96.1723   94.0660   89.6920   83.7455   79.8849   74.4489   69.8284   75.7484   77.8519   84.0066   90.9563   94.0748 (72)
Total internal gains
              389.7423  387.7228  374.6445  353.5350  332.1155  311.4296  297.9545  303.7878  314.5955  335.9132  360.4219  378.7902 (73)
```

```
6. Solar gains

[Jan]                                 Area       Solar flux            g             FF          Access            Gains
                                        m2         Table 6a  Specific data  Specific data        factor                W
                                                       W/m2    or Table 6b    or Table 6c      Table 6d

South                                7.5800         46.7521         0.6300         0.7000        0.7700         108.3033 (78)
Southwest                            9.4800         36.7938         0.6300         0.7000        0.7700         106.5995 (79)

Solar gains   214.9028  358.9514  474.3852  563.1967  610.9034  598.3949  580.2339  545.4343  505.0345  391.9962  256.0580  184.8110 (83)
Total gains   604.6452  746.6741  849.0296  916.7316  943.0188  909.8245  878.1885  849.2221  819.6300  727.9094  616.4799  563.6012 (84)
```

```
7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)                                             21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          71.8960   72.1279   72.3566   73.4506   73.6590   74.6447   74.6447   74.8302   74.2619   73.6590   73.2387   72.8043
alpha         5.7931    5.8085    5.8238    5.8967    5.9106    5.9763    5.9763    5.9887    5.9508    5.9106    5.8826    5.8536
util living area
              0.9919    0.9741    0.9321    0.8362    0.6832    0.4985    0.3575    0.3853    0.5923    0.8694    0.9781    0.9944 (86)

MIT          20.1914   20.4136   20.6486   20.8577   20.9630   20.9952   20.9994   20.9991   20.9871   20.8473   20.4805   20.1500 (87)
Th 2         20.1118   20.1145   20.1170   20.1290   20.1313   20.1418   20.1418   20.1437   20.1377   20.1313   20.1267   20.1220 (88)
util rest of house
              0.9895    0.9669    0.9146    0.8005    0.6290    0.4335    0.2880    0.3140    0.5233    0.8315    0.9708    0.9926 (89)
MIT 2        19.0469   19.3671   19.6955   19.9774   20.0990   20.1389   20.1416   20.1434   20.1290   19.9734   19.4756   18.9946 (90)
Living area fraction                                                                 fLA = Living area / (4) =     0.4583 (91)
MIT          19.5714   19.8467   20.1323   20.3809   20.4950   20.5314   20.5348   20.5356   20.5223   20.3739   19.9362   19.5242 (92)
Temperature adjustment                                                                                             0.0000
adjusted MIT 19.5714   19.8467   20.1323   20.3809   20.4950   20.5314   20.5348   20.5356   20.5223   20.3739   19.9362   19.5242 (93)
```

```
8. Space heating requirement

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9876    0.9643    0.9149    0.8114    0.6522    0.4632    0.3199    0.3467    0.5545    0.8430    0.9688    0.9911 (94)
Useful gains  597.1174  719.9979  776.8029  743.8777  615.0570  421.4281  280.9266  294.4151  454.5255  613.6082  597.2456  558.5852 (95)
Ext temp.       4.3000    4.9000    6.5000    8.9000   11.7000   14.6000   16.6000   16.4000   14.1000   10.6000    7.1000    4.2000 (96)
Heat loss rate W
             1132.8533 1105.2035 1004.8251  833.6414  636.8083  423.7940  281.1381  294.7559  461.2375  707.6874  934.7469 1122.5833 (97)
Month fracti    1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
              398.5875  258.8582  169.6485   64.6299   16.1830    0.0000    0.0000    0.0000    0.0000   69.9949  243.0010  419.6146 (98)
Space heating                                                                                                  1640.5175 (98)
Space heating per m2                                                                             (98) / (4) =    21.3609 (99)
```

```
8c. Space cooling requirement

Not applicable
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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014


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9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                     93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                               0.0000 (208)
Space heating requirement                                                                                          1754.5642 (211)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Space heating requirement
             398.5875  258.8582  169.6485   64.6299   16.1830    0.0000    0.0000    0.0000    0.0000   69.9949  243.0010  419.6146 (98)
Space heating efficiency (main heating system 1)
              93.5000   93.5000   93.5000   93.5000   93.5000    0.0000    0.0000    0.0000    0.0000   93.5000   93.5000   93.5000 (210)
Space heating fuel (main heating system)
             426.2968  276.8537  181.4422   69.1229   17.3080    0.0000    0.0000    0.0000    0.0000   74.8609  259.8941  448.7857 (211)
Water heating requirement
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (215)

Water heating
Water heating requirement
             176.3638  155.0393  161.8633  143.7654  139.9190  123.6343  117.4167  130.6634  131.0032  149.1418  159.3799  171.6703 (64)
Efficiency of water heater                                                                                          79.8000 (216)
(217)m        86.9248   86.1719   84.9392   82.8374   80.7902   79.8000   79.8000   79.8000   79.8000   82.9319   85.9359   87.1089 (217)
Fuel for water heating, kWh/month
             202.8924  179.9186  190.5638  173.5512  173.1880  154.9302  147.1388  163.7386  164.1644  179.8365  185.4636  197.0755 (219)
Water heating fuel used                                                                                           2112.4615 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                  1754.5642 (211)
Space heating fuel - secondary                                                                                       0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                             30.0000 (230c)
   main heating flue fan                                                                                            45.0000 (230e)
Total electricity for the above, kWh/year                                                                           75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                334.7862 (232)
Total delivered energy for all uses                                                                               4276.8119 (238)
```

```
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

                                                                        Energy     Emission factor        Emissions
                                                                     kWh/year          kg CO2/kWh      kg CO2/year
Space heating - main system 1                                        1754.5642              0.2160         378.9859 (261)
Space heating - secondary                                               0.0000              0.0000           0.0000 (263)
Water heating (other fuel)                                           2112.4615              0.2160         456.2917 (264)
Space and water heating                                                                                    835.2776 (265)
Pumps and fans                                                         75.0000              0.5190          38.9250 (267)
Energy for lighting                                                   334.7862              0.5190         173.7540 (268)
Total CO2, kg/m2/year                                                                                     1047.9566 (272)
Emissions per m2 for space and water heating                                                                10.8760 (272a)
Fuel factor (electricity)                                                                                    1.5500
Emissions per m2 for lighting                                                                                2.2624 (272b)
Emissions per m2 for pumps and fans                                                                          0.5068 (272c)
Target Carbon Dioxide Emission Rate (TER) = (10.8760 * 1.55) + 2.2624 + 0.5068, rounded to 2 d.p.          19.6300 (273)
```

Property Reference	03 - 009 B3 - 1B2P	**Issued on Date**	15/12/2020
Assessment Reference	1B2P Be Clean	**Prop Type Ref**	Top floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	80 C	**DER**	19.29	**TER**	34.40
Environmental	88 B	**% DER<TER**	43.92		
CO_2 Emissions (t/year)	0.79	**DFEE**	60.04	**TFEE**	71.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.08		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 52 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 34.40 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.29 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)71.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)60.0 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.18 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.10 (max. 0.20)        0.10 (max. 0.35)          OK
Openings        1.31 (max. 2.00)        1.40 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                            -

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                          OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.42
Maximum                                 1.5                                                 OK
MVHR efficiency:                        91%
Minimum:                                70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                              OK
Based on:
Overshading:                            Average
Windows facing North East:              7.98 m², No overhang
Windows facing North West:              3.00 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.10 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	51.6000 (1b)	x	2.5000 (2b)	=	129.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 51.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	129.0000 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans							0 * 10 =	0.0000 (7a)
Number of passive vents							0 * 10 =	0.0000 (7b)
Number of flueless gas fires							0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design AP50		3.0000
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.3500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2758	0.2726	0.2694	0.2535	0.2503	0.2344	0.2344	0.2312	0.2408	0.2503	0.2567	0.2631	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window Double-Glazed (Uw = 1.40)			10.9800	1.3258	14.5568			(27)
Door			2.1200	0.8200	1.7384			(26)
External Wall	42.9000	10.9800	31.9200	0.1800	5.7456			(29a)
Wall to CA	20.1000	2.1200	17.9800	0.1671	3.0039			(29a)
External Roof 1	51.6000		51.6000	0.1000	5.1600			(30)
Total net area of external elements Aum(A, m2)			114.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.2047			(33)
Party Wall 1			22.8000	0.0000	0.0000			(32)
Party Floor 1			51.6000					(32d)
Party Ceilings 1			51.6000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.4892 (36)
Total fabric heat loss (33) + (36) = 44.6939 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	11.7413	11.6056	11.4700	10.7915	10.6558	9.9773	9.9773	9.8417	10.2487	10.6558	10.9272	11.1986	(38)
Heat transfer coeff	56.4353	56.2996	56.1639	55.4854	55.3497	54.6713	54.6713	54.5356	54.9426	55.3497	55.6211	55.8925	(39)

Average = Sum(39)m / 12 = 55.4515 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0937	1.0911	1.0884	1.0753	1.0727	1.0595	1.0595	1.0569	1.0648	1.0727	1.0779	1.0832	(40)
HLP (average)												1.0746	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7373 (42)
Average daily hot water use (litres/day) 75.4602 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	83.0062	79.9878	76.9694	73.9510	70.9326	67.9141	67.9141	70.9326	73.9510	76.9694	79.9878	83.0062	(44)
Energy conte	123.0958	107.6603	111.0958	96.8560	92.9357	80.1964	74.3138	85.2761	86.2946	100.5680	109.7779	119.2117	(45)

Energy content (annual) Total = Sum(45)m = 1187.2821 (45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss	18.4644	16.1491	16.6644	14.5284	13.9404	12.0295	11.1471	12.7914	12.9442	15.0852	16.4667	17.8818	(46)

Water storage loss:
Store volume 3.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0212 (51)
Volume factor from Table 2a 3.4200 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 0.2173 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(56)
If cylinder contains dedicated solar storage	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	153.0935	134.7550	141.0935	125.8861	122.9334	109.2264	104.3115	115.2738	115.3246	130.5657	138.8079	149.2094	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	153.0935	134.7550	141.0935	125.8861	122.9334	109.2264	104.3115	115.2738	115.3246	130.5657	138.8079	149.2094	(64)
Total per year (kWh/year) = Sum(64)m =												1540.4808	(64)
Heat gains from water heating, kWh/month	64.9275	57.4728	60.9375	55.4287	54.8993	49.8893	48.7075	52.3525	51.9170	57.4370	59.7252	63.6360	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5218	12.0099	9.7671	7.3943	5.5274	4.6664	5.0422	6.5541	8.7969	11.1697	13.0367	13.8976	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	151.3882	152.9591	149.0004	140.5728	129.9344	119.9359	113.2562	111.6853	115.6440	124.0716	134.7100	144.7085	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	(71)
Water heating gains (Table 5)	87.2681	85.5250	81.9053	76.9842	73.7893	69.2907	65.4670	70.3662	72.1069	77.2003	82.9516	85.5323	(72)
Total internal gains	301.2371	299.5531	289.7318	274.0104	258.3102	242.9521	232.8246	237.6647	245.6069	261.5007	279.7573	293.1975	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.9800	11.2829	0.4000	0.7000	0.7700	17.4709	(75)
Northwest	3.0000	11.2829	0.4000	0.7000	0.7700	6.5680	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	24.0390	48.9320	88.1600	144.7840	194.6181	207.4834	194.0965	154.7360	107.4243	59.7988	30.2473	19.6314	(83)
Total gains	325.2761	348.4851	377.8918	418.7944	452.9282	450.4355	426.9211	392.4007	353.0311	321.2995	310.0046	312.8289	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.4946	63.6476	63.8014	64.5815	64.7399	65.5433	65.5433	65.7064	65.2195	64.7399	64.4240	64.1112	
alpha	5.2330	5.2432	5.2534	5.3054	5.3160	5.3696	5.3696	5.3804	5.3480	5.3160	5.2949	5.2741	
util living area	0.9975	0.9959	0.9904	0.9676	0.8903	0.7210	0.5519	0.6173	0.8709	0.9796	0.9952	0.9980	(86)
MIT	19.8635	19.9709	20.1899	20.5089	20.7941	20.9534	20.9908	20.9840	20.8675	20.5184	20.1431	19.8451	(87)
Th 2	20.0060	20.0081	20.0103	20.0211	20.0232	20.0340	20.0340	20.0362	20.0297	20.0232	20.0189	20.0146	(88)
util rest of house	0.9967	0.9945	0.9869	0.9550	0.8487	0.6337	0.4368	0.4989	0.8068	0.9693	0.9933	0.9973	(89)
MIT 2	18.4918	18.6500	18.9701	19.4343	19.8170	20.0025	20.0305	20.0293	19.9188	19.4551	18.9097	18.4712	(90)
Living area fraction									fLA = Living area / (4) =			0.5814	(91)
MIT	19.2893	19.4179	19.6793	20.0591	20.3851	20.5554	20.5889	20.5844	20.4704	20.0733	19.6268	19.2700	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2893	19.4179	19.6793	20.0591	20.3851	20.5554	20.5889	20.5844	20.4704	20.0733	19.6268	19.2700	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9958	0.9934	0.9855	0.9556	0.8656	0.6827	0.5039	0.5679	0.8388	0.9700	0.9923	0.9966	(94)
Useful gains	323.9256	346.1848	372.3998	400.1862	392.0642	307.5056	215.1405	222.8612	296.1295	311.6545	307.6272	311.7676	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	845.9259	817.3529	740.1992	619.1653	480.7166	325.5872	218.0757	228.1969	350.0046	524.3423	696.7554	842.2985	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	388.3682	316.6250	273.6428	157.6650	65.9574	0.0000	0.0000	0.0000	0.0000	158.2397	280.1723	394.7150	(98)

Space heating 2035.3852 (98)
Space heating per m2 (98) / (4) = 39.4454 (99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                0.0000 (301)
Fraction of space heat from community system                                                         1.0000 (302)
Fraction of heat from community Heat pump                                                            1.0000 (303b)
Fraction of total space heat from community Heat pump                                                1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating                    1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                    1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                   1.3000 (306)
Space heating:
Annual space heating requirement                                                                  2035.3852 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                                             2646.0008 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)             0.0000 (308)
Space heating fuel for secondary/supplementary system                                               0.0000 (309)

Water heating
Annual water heating requirement                                                                  1540.4808 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                                             2002.6250 (310b)
Electricity used for heat distribution                                                              46.4863 (313)
Annual totals kWh/year

Electricity for pumps and fans:
   (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)
  mechanical ventilation fans (SFP =       0.5250)                                                  82.6245 (330a)
Total electricity for the above, kWh/year                                                           82.6245 (331)
Electricity for lighting (calculated in Appendix L)                                                238.7986 (332)
Total delivered energy for all uses                                                               4970.0489 (338)


-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                   Energy    Emission factor          Emissions
                                                                 kWh/year        kg CO2/kWh         kg CO2/year
Efficiency of heat source Heat pump                                                                300.0000 (367b)
Space heating from Heat pump                                    1549.5419            0.5190            804.2123 (368)
Electrical energy for heat distribution                           46.4863            0.5190             24.1264 (372)
Total CO2 associated with community systems                                                           828.3386 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                                               828.3386 (376)
Pumps and fans                                                    82.6245            0.5190             42.8821 (378)
Energy for lighting                                              238.7986            0.5190            123.9365 (379)
Total CO2, kg/year                                                                                    995.1572 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                            19.2900 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                    19.2900 ZC1
Total Floor Area                                                                               TFA    51.6000
Assumed number of occupants                                                                      N     1.7373
CO2 emission factor in Table 12 for electricity displaced from grid                             EF     0.5190
CO2 emissions from appliances, equation (L14)                                                         17.3856 ZC2
CO2 emissions from cooking, equation (L16)                                                             3.1142 ZC3
Total CO2 emissions                                                                                   39.7898 ZC4
Residual CO2 emissions offset from biofuel CHP                                                         0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                               0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                        0.0000 ZC7
Net CO2 emissions                                                                                     39.7898 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------


-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                         Area         Storey height                Volume
                                                                         (m2)                   (m)                  (m3)
Ground floor                                                        51.6000 (1b)    x     2.5000 (2b)    =    129.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)        51.6000                                                  (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    129.0000 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                 main          secondary              other            total       m3 per hour
                                              heating            heating
Number of chimneys                                  0     +            0     +            0     =       0 * 40 =       0.0000 (6a)
Number of open flues                                0     +            0     +            0     =       0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                             2 * 10 =      20.0000 (7a)
Number of passive vents                                                                                 0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                            0 * 40 =       0.0000 (7c)

                                                                                                    Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                    20.0000 / (5) =       0.1550 (8)
Pressure test                                                                                                          Yes
Measured/design AP50                                                                                                5.0000
Infiltration rate                                                                                                   0.4050 (18)
Number of sides sheltered                                                                                                2 (19)

Shelter factor                                                                (20) = 1  -  [0.075 x (19)]  =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                               (21) = (18) x (20)  =       0.3443 (21)


              Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.4390    0.4304    0.4217    0.3787    0.3701    0.3271    0.3271    0.3185    0.3443    0.3701    0.3873    0.4045 (22b)
Effective ac  0.5963    0.5926    0.5889    0.5717    0.5685    0.5535    0.5535    0.5507    0.5593    0.5685    0.5750    0.5818 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                   Gross    Openings     NetArea     U-value       A x U     K-value       A x K
                                             m2          m2          m2      W/m2K         W/K      kJ/m2K        kJ/K
TER Opaque door                                                  2.1200      1.0000      2.1200                          (26)
TER Opening Type (Uw = 1.40)                                    10.7900      1.3258     14.3049                          (27)
External Wall                           42.9000     10.7900     32.1100      0.1800      5.7798                          (29a)
Wall to CA                              20.1000      2.1200     17.9800      0.1800      3.2364                          (29a)
External Roof 1                         51.6000                 51.6000      0.1300      6.7080                          (30)
Total net area of external elements Aum(A, m2)                 114.6000                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                         (26)...(30) + (32) =     32.1491                          (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                         250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                 15.3157 (36)
Total fabric heat loss                                                                    (33) + (36) =    47.4648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
              Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
(38)m        25.3863   25.2271   25.0710   24.3377   24.2006   23.5619   23.5619   23.4437   23.8079   24.2006   24.4781   24.7682 (38)
Heat transfer coeff
             72.8512   72.6919   72.5358   71.8026   71.6654   71.0268   71.0268   70.9085   71.2728   71.6654   71.9429   72.2330 (39)
Average = Sum(39)m / 12 =                                                                                         71.8019 (39)

              Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP           1.4118    1.4088    1.4057    1.3915    1.3889    1.3765    1.3765    1.3742    1.3813    1.3889    1.3942    1.3999 (40)
HLP (average)                                                                                                      1.3915 (40)
Days in month
                  31        28        31        30        31        30        31        31        30        31        30        31 (41)


-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                  1.7373 (42)
Average daily hot water use (litres/day)                                                                          75.4602 (43)

              Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             83.0062   79.9878   76.9694   73.9510   70.9326   67.9141   67.9141   70.9326   73.9510   76.9694   79.9878   83.0062 (44)
Energy conte 123.0958  107.6603  111.0958   96.8560   92.9357   80.1964   74.3138   85.2761   86.2946  100.5680  109.7779  119.2117 (45)
Energy content (annual)                                                                       Total = Sum(45)m =  1187.2821 (45)
Distribution loss  (46)m = 0.15 x (45)m
             18.4644   16.1491   16.6644   14.5284   13.9404   12.0295   11.1471   12.7914   12.9442   15.0852   16.4667   17.8818 (46)
Water storage loss:
Store volume                                                                                                       3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                      0.2602 (48)
  Temperature factor from Table 2b                                                                                 0.5400 (49)
Enter (49) or (54) in (55)                                                                                         0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	150.7134	132.6053	138.7135	123.5828	120.5533	106.9232	101.9314	112.8938	113.0214	128.1857	136.5047	146.8293	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	150.7134	132.6053	138.7135	123.5828	120.5533	106.9232	101.9314	112.8938	113.0214	128.1857	136.5047	146.8293	(64)
Total per year (kWh/year) = Sum(64)m =												1512.4580	(64)
Heat gains from water heating, kWh/month	63.0235	55.7531	59.0335	53.5861	52.9952	48.0467	46.8035	50.4485	50.0744	55.5330	57.8826	61.7320	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	86.8635	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5375	12.0239	9.7785	7.4029	5.5338	4.6719	5.0481	6.5617	8.8071	11.1827	13.0518	13.9138	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	151.3882	152.9591	149.0004	140.5728	129.9344	119.9359	113.2562	111.6853	115.6440	124.0716	134.7100	144.7085	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	31.6863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	-69.4908	(71)
Water heating gains (Table 5)	84.7090	82.9659	79.3461	74.4251	71.2302	66.7316	62.9079	67.8071	69.5478	74.6411	80.3925	82.9731	(72)
Total internal gains	301.6937	300.0079	290.1841	274.4599	258.7575	243.3984	233.2713	238.1131	246.0579	261.9545	280.2133	293.6545	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.8400	11.2829	0.6300	0.7000	0.7700	27.0340	(75)
Northwest	2.9500	11.2829	0.6300	0.7000	0.7700	10.1722	(81)

Solar gains	37.2062	75.7343	136.4492	224.0888	301.2193	321.1317	300.4121	239.4920	166.2655	92.5534	46.8151	30.3845	(83)
Total gains	338.9000	375.7423	426.6333	498.5487	559.9768	564.5300	533.6834	477.6051	412.3234	354.5079	327.0284	324.0390	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.1870	49.2948	49.4009	49.9054	50.0009	50.4505	50.4505	50.5346	50.2763	50.0009	49.8080	49.6080	
alpha	4.2791	4.2863	4.2934	4.3270	4.3334	4.3634	4.3634	4.3690	4.3518	4.3334	4.3205	4.3072	
util living area	0.9970	0.9948	0.9875	0.9594	0.8758	0.7165	0.5607	0.6360	0.8771	0.9786	0.9946	0.9975	(86)
MIT	19.4734	19.6155	19.9036	20.3192	20.6929	20.9125	20.9768	20.9608	20.7727	20.3051	19.8242	19.4502	(87)
Th 2	19.7543	19.7566	19.7589	19.7698	19.7719	19.7814	19.7814	19.7832	19.7777	19.7719	19.7678	19.7634	(88)
util rest of house	0.9959	0.9929	0.9828	0.9428	0.8255	0.6129	0.4176	0.4896	0.8054	0.9670	0.9923	0.9966	(89)
MIT 2	17.7484	17.9571	18.3772	18.9771	19.4749	19.7250	19.7735	19.7677	19.5921	18.9685	18.2700	17.7205	(90)
Living area fraction									fLA = Living area / (4) =			0.5814	(91)
MIT	18.7513	18.9212	19.2647	19.7574	20.1831	20.4154	20.4731	20.4613	20.2785	19.7456	19.1736	18.7261	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7513	18.9212	19.2647	19.7574	20.1831	20.4154	20.4731	20.4613	20.2785	19.7456	19.1736	18.7261	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9912	0.9803	0.9426	0.8443	0.6699	0.5012	0.5749	0.8389	0.9667	0.9908	0.9956	(94)
Useful gains	337.0971	372.4327	418.2326	469.9336	472.7832	378.1643	267.4775	274.5545	345.8856	342.7134	324.0161	322.6162	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1052.7940	1019.2308	925.8947	779.5880	607.9414	413.0491	275.0914	287.9831	440.3596	655.4243	868.6111	1049.2647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	532.4785	434.6483	377.7006	222.9512	100.5577	0.0000	0.0000	0.0000	0.0000	232.6569	392.1084	540.6264	(98)
Space heating												2833.7280	(98)
Space heating per m2											(98) / (4) =	54.9172	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3030.7252	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	532.4785	434.6483	377.7006	222.9512	100.5577	0.0000	0.0000	0.0000	0.0000	232.6569	392.1084	540.6264	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	569.4957	464.8645	403.9578	238.4505	107.5484	0.0000	0.0000	0.0000	0.0000	248.8309	419.3673	578.2101	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	150.7134	132.6053	138.7135	123.5828	120.5533	106.9232	101.9314	112.8938	113.0214	128.1857	136.5047	146.8293	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9000	87.7495	87.3538	86.3699	84.3347	79.8000	79.8000	79.8000	79.8000	86.3853	87.4713	87.9804	(217)
Fuel for water heating, kWh/month	171.4602	151.1180	158.7950	143.0854	142.9464	133.9890	127.7336	141.4709	141.6308	148.3884	156.0565	166.8887	(219)
Water heating fuel used												1783.5630	(219)

Annual totals kWh/year		
Space heating fuel - main system	3030.7252	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	239.0768	(232)
Total delivered energy for all uses	5128.3649	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3030.7252	0.2160	654.6366	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1783.5630	0.2160	385.2496	(264)
Space and water heating			1039.8862	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	239.0768	0.5190	124.0808	(268)
Total CO2, kg/m2/year			1202.8921	(272)
Emissions per m2 for space and water heating			20.1528	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4047	(272b)
Emissions per m2 for pumps and fans			0.7544	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.1528 * 1.55) + 2.4047 + 0.7544, rounded to 2 d.p.			34.4000	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	03 - 010 B1 - 2B4P	**Issued on Date**	15/12/2020
Assessment Reference	2B4P Be Clean	**Prop Type Ref**	Top floor
Property	Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	82 B	**DER**	16.18	**TER**	28.38
Environmental	88 B	**% DER<TER**	42.99		
CO_2 Emissions (t/year)	0.98	**DFEE**	52.44	**TFEE**	60.81
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.76		

Assessor Details	Miss Eleanor Ballinger, Hodkinson Consultancy Ltd, Tel: 0203 603 1625, Eleanor@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 78 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 28.38 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.18 kgCO□/m²OK
------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.4 kWh/m²/yrOK
------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.17 (max. 0.30)        0.18 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.10 (max. 0.20)        0.10 (max. 0.35)          OK
Openings        1.33 (max. 2.00)        1.40 (max. 3.30)          OK
------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Community heating scheme                          -

Secondary heating system:               None
------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 0.22 kWh/day
Permitted by DBSCG 0.35                           OK
Primary pipework insulated:             No primary pipework
------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, programmer and at least two room statsOK


Hot water controls:                     No cylinderstat


------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.44
Maximum                                 1.5                                               OK
MVHR efficiency:                        91%
Minimum:                                70%                                               OK
------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Midlands):            Slight                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              8.10 m², No overhang
Windows facing South East:              8.10 m², No overhang
Air change rate:                        2.00 ach
Blinds/curtains:                        None
------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.10 W/m²K
Door U-value                            0.82 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.6000 (1b)	x	2.5000 (2b)	=	194.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	194.0000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.3500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2758	0.2726	0.2694	0.2535	0.2503	0.2344	0.2344	0.2312	0.2408	0.2503	0.2567	0.2631	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window Double-Glazed (Uw = 1.40)			16.2000	1.3258	21.4773			(27)
Door			2.1200	0.8200	1.7384			(26)
External Wall	53.4800	16.2000	37.2800	0.1800	6.7104			(29a)
Wall to CA	29.6300	2.1200	27.5100	0.1671	4.5961			(29a)
External Roof 1	77.6000		77.6000	0.1000	7.7600			(30)
Total net area of external elements Aum(A, m2)			160.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.2821			(33)
Party Wall 1			25.9500	0.0000	0.0000			(32)
Party Floor 1			77.6000					(32d)
Party Ceilings 1			77.6000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.5436	(36)
Total fabric heat loss	(33) + (36) =	59.8257	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	17.6575	17.4535	17.2494	16.2291	16.0250	15.0047	15.0047	14.8006	15.4128	16.0250	16.4331	16.8413	(38)
Heat transfer coeff	77.4833	77.2792	77.0751	76.0548	75.8507	74.8304	74.8304	74.6264	75.2386	75.8507	76.2589	76.6670	(39)
Average = Sum(39)m / 12 =												76.0038	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9985	0.9959	0.9932	0.9801	0.9775	0.9643	0.9643	0.9617	0.9696	0.9775	0.9827	0.9880	(40)
HLP (average)												0.9794	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.4157	(42)
Average daily hot water use (litres/day)	91.5740	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.7313	97.0684	93.4054	89.7425	86.0795	82.4166	82.4166	86.0795	89.7425	93.4054	97.0684	100.7313	(44)
Energy conte	149.3817	130.6502	134.8193	117.5387	112.7812	97.3216	90.1828	103.4860	104.7220	122.0434	133.2199	144.6682	(45)
Energy content (annual)											Total = Sum(45)m =	1440.8149	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	22.4073	19.5975	20.2229	17.6308	16.9172	14.5982	13.5274	15.5229	15.7083	18.3065	19.9830	21.7002	(46)

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0212	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	1.0000	(53)
Enter (49) or (54) in (55)	0.2173	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(56)
If cylinder contains dedicated solar storage	6.7353	6.0835	6.7353	6.5180	6.7353	6.5180	6.7353	6.7353	6.5180	6.7353	6.5180	6.7353	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	179.3794	157.7449	164.8170	146.5687	142.7789	126.3516	120.1805	133.4837	133.7520	152.0411	162.2499	174.6659	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	179.3794	157.7449	164.8170	146.5687	142.7789	126.3516	120.1805	133.4837	133.7520	152.0411	162.2499	174.6659	(64)
								Total per year (kWh/year) = Sum(64)m =				1794.0135	(64)
Heat gains from water heating, kWh/month	73.6676	65.1169	68.8256	62.3056	61.4979	55.5835	53.9839	58.4073	58.0441	64.5776	67.5196	72.1003	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.1702	17.0268	13.8471	10.4832	7.8363	6.6157	7.1485	9.2919	12.4716	15.8356	18.4824	19.7030	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	214.3515	216.5758	210.9707	199.0380	183.9750	169.8180	160.3603	158.1360	163.7411	175.6738	190.7368	204.8938	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	(71)
Water heating gains (Table 5)	99.0155	96.9002	92.5075	86.5356	82.6585	77.1992	72.5590	78.5044	80.6168	86.7978	93.7773	96.9090	(72)
Total internal gains	391.7735	389.7390	376.5615	355.2929	333.7060	312.8692	299.3040	305.1685	316.0657	337.5434	362.2327	380.7420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.1000	11.2829	0.4000	0.7000	0.7700	17.7337	(75)
Southeast	8.1000	36.7938	0.4000	0.7000	0.7700	57.8297	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	75.5634	134.6029	199.8155	273.8061	330.6227	338.7609	322.2199	278.2225	225.1851	152.9834	91.5803	63.9724	(83)
Total gains	467.3369	524.3419	576.3770	629.0991	664.3287	651.6301	621.5239	583.3910	541.2508	490.5268	453.8129	444.7144	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	69.5491	69.7327	69.9174	70.8553	71.0460	72.0147	72.0147	72.2116	71.6240	71.0460	70.6657	70.2896	
alpha	5.6366	5.6488	5.6612	5.7237	5.7364	5.8010	5.8010	5.8141	5.7749	5.7364	5.7110	5.6860	
util living area	0.9979	0.9956	0.9885	0.9611	0.8759	0.6977	0.5234	0.5770	0.8341	0.9742	0.9955	0.9984	(86)
MIT	19.9700	20.1008	20.3175	20.6058	20.8456	20.9696	20.9951	20.9917	20.9153	20.6114	20.2407	19.9475	(87)
Th 2	20.0846	20.0868	20.0890	20.1000	20.1022	20.1132	20.1132	20.1154	20.1088	20.1022	20.0978	20.0934	(88)
util rest of house	0.9973	0.9941	0.9844	0.9470	0.8333	0.6160	0.4213	0.4719	0.7662	0.9620	0.9937	0.9979	(89)
MIT 2	18.7047	18.8970	19.2132	19.6315	19.9489	20.0927	20.1113	20.1118	20.0403	19.6467	19.1100	18.6784	(90)
Living area fraction									fLA = Living area / (4) =			0.4253	(91)
MIT	19.2428	19.4089	19.6828	20.0459	20.3303	20.4656	20.4871	20.4860	20.4124	20.0570	19.5909	19.2181	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2428	19.4089	19.6828	20.0459	20.3303	20.4656	20.4871	20.4860	20.4124	20.0570	19.5909	19.2181	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9927	0.9821	0.9459	0.8452	0.6497	0.4649	0.5169	0.7914	0.9613	0.9924	0.9972	(94)
Useful gains	465.6568	520.5047	566.0699	595.0909	561.4950	423.3921	288.9729	301.5338	428.3716	471.5279	450.3466	443.4906	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1157.8135	1121.2369	1016.0636	847.6956	654.6116	438.9256	290.8749	304.9224	474.9331	717.3185	952.5406	1151.3913	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	514.9646	403.6921	334.7953	181.8754	69.2788	0.0000	0.0000	0.0000	0.0000	182.8682	361.5797	526.6781	(98)
Space heating												2575.7321	(98)
Space heating per m2											(98) / (4) =	33.1924	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
--------------------------------------------------------------------------------------------------
Not applicable


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9b. Energy requirements
--------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                 0.0000 (301)
Fraction of space heat from community system                                          1.0000 (302)
Fraction of heat from community Heat pump                                             1.0000 (303b)
Fraction of total space heat from community Heat pump                                 1.0000 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating      1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating      1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                     1.3000 (306)
Space heating:
Annual space heating requirement                                                   2575.7321 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.30                              3348.4517 (307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)
Space heating fuel for secondary/supplementary system                                 0.0000 (309)

Water heating
Annual water heating requirement                                                   1794.0135 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.30                              2332.2176 (310b)
Electricity used for heat distribution                                               56.8067 (313)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)
   mechanical ventilation fans (SFP =       0.5500)                                 130.1740 (330a)
Total electricity for the above, kWh/year                                           130.1740 (331)
Electricity for lighting (calculated in Appendix L)                                 338.5518 (332)
Total delivered energy for all uses                                                6149.3951 (338)


--------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
--------------------------------------------------------------------------------------------------
                                                     Energy    Emission factor      Emissions
                                                   kWh/year       kg CO2/kWh      kg CO2/year
Efficiency of heat source Heat pump                                                300.0000 (367b)
Space heating from Heat pump                      1893.5564           0.5190       982.7558 (368)
Electrical energy for heat distribution             56.8067           0.5190        29.4827 (372)
Total CO2 associated with community systems                                       1012.2385 (373)
 (negative value allowed since DFEE <= TFEE)
Space and water heating                                                           1012.2385 (376)
Pumps and fans                                     130.1740           0.5190        67.5603 (378)
Energy for lighting                                338.5518           0.5190       175.7084 (379)
Total CO2, kg/year                                                                1255.5072 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                         16.1800 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                 16.1800 ZC1
Total Floor Area                                                          TFA       77.6000
Assumed number of occupants                                                 N        2.4157
CO2 emission factor in Table 12 for electricity displaced from grid        EF        0.5190
CO2 emissions from appliances, equation (L14)                                       16.3686 ZC2
CO2 emissions from cooking, equation (L16)                                           2.2806 ZC3
Total CO2 emissions                                                                 34.8292 ZC4
Residual CO2 emissions offset from biofuel CHP                                       0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                             0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation      0.0000 ZC7
Net CO2 emissions                                                                   34.8292 ZC8


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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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--------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
--------------------------------------------------------------------------------------------------
                                                               Area        Storey height          Volume
                                                               (m2)              (m)               (m3)
Ground floor                                                77.6000 (1b)   x   2.5000 (2b)   =  194.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)      77.6000                                      (4)
Dwelling volume                                             (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =  194.0000 (5)


--------------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------------
                                        main        secondary          other           total      m3 per hour
                                     heating          heating
Number of chimneys                         0     +          0     +        0     =       0 * 40 =     0.0000 (6a)
Number of open flues                       0     +          0     +        0     =       0 * 20 =     0.0000 (6b)
Number of intermittent fans                                                              3 * 10 =    30.0000 (7a)
Number of passive vents                                                                  0 * 10 =     0.0000 (7b)
Number of flueless gas fires                                                             0 * 40 =     0.0000 (7c)

                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =          30.0000 / (5) =    0.1546 (8)
Pressure test                                                                                          Yes
Measured/design AP50                                                                                5.0000
Infiltration rate                                                                                   0.4046 (18)
Number of sides sheltered                                                                                2 (19)

Shelter factor                                                     (20) = 1 - [0.075 x (19)] =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                   (21) = (18) x (20)  =      0.3439 (21)


                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Wind speed     5.1000   5.0000   4.9000   4.4000   4.3000   3.8000   3.8000   3.7000   4.0000   4.3000   4.5000   4.7000 (22)
Wind factor    1.2750   1.2500   1.2250   1.1000   1.0750   0.9500   0.9500   0.9250   1.0000   1.0750   1.1250   1.1750 (22a)
Adj infilt rate
               0.4385   0.4299   0.4213   0.3783   0.3697   0.3267   0.3267   0.3181   0.3439   0.3697   0.3869   0.4041 (22b)
Effective ac   0.5962   0.5924   0.5888   0.5716   0.5684   0.5534   0.5534   0.5506   0.5591   0.5684   0.5749   0.5817 (25)


--------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
--------------------------------------------------------------------------------------------------
Element                                   Gross   Openings    NetArea    U-value      A x U    K-value      A x K
                                             m2         m2         m2      W/m2K        W/K     kJ/m2K       kJ/K
TER Opaque door                                                2.1200     1.0000     2.1200                      (26)
TER Opening Type (Uw = 1.40)                                  16.2000     1.3258    21.4773                      (27)
External Wall                           53.4800    16.2000    37.2800     0.1800     6.7104                      (29a)
Wall to CA                              29.6300     2.1200    27.5100     0.1800     4.9518                      (29a)
External Roof 1                         77.6000               77.6000     0.1300    10.0880                      (30)
Total net area of external elements Aum(A, m2)               160.7100                                            (31)
Fabric heat loss, W/K = Sum (A x U)                     (26)...(30) + (32) =      45.3475                      (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                      250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                              18.4278 (36)
Total fabric heat loss                                                                (33) + (36) =     63.7753 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
(38)m         38.1657  37.9267  37.6924  36.5919  36.3860  35.4275  35.4275  35.2500  35.7967  36.3860  36.8025  37.2380 (38)
Heat transfer coeff
             101.9410 101.7020 101.4677 100.3672 100.1613  99.2028  99.2028  99.0253  99.5720 100.1613 100.5778 101.0133 (39)
Average = Sum(39)m / 12 =                                                                                      100.3662 (39)

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
HLP            1.3137   1.3106   1.3076   1.2934   1.2907   1.2784   1.2784   1.2761   1.2831   1.2907   1.2961   1.3017 (40)
HLP (average)                                                                                                    1.2934 (40)
Days in month
                   31       28       31       30       31       30       31       31       30       31       30       31 (41)


--------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
--------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                               2.4157 (42)
Average daily hot water use (litres/day)                                                                       91.5740 (43)

                  Jan      Feb      Mar      Apr      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
Daily hot water use
             100.7313  97.0684  93.4054  89.7425  86.0795  82.4166  82.4166  86.0795  89.7425  93.4054  97.0684 100.7313 (44)
Energy conte 149.3817 130.6502 134.8193 117.5387 112.7812  97.3216  90.1828 103.4860 104.7220 122.0434 133.2199 144.6682 (45)
Energy content (annual)                                                                  Total = Sum(45)m = 1440.8149 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.4073  19.5975  20.2229  17.6308  16.9172  14.5982  13.5274  15.5229  15.7083  18.3065  19.9830  21.7002 (46)
Water storage loss:
Store volume                                                                                                    3.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                   0.2602 (48)
  Temperature factor from Table 2b                                                                              0.5400 (49)
Enter (49) or (54) in (55)                                                                                      0.1405 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(64)
Total per year (kWh/year) = Sum(64)m =												1765.9907	(64)
Heat gains from water heating, kWh/month	71.7635	63.3972	66.9215	60.4630	59.5939	53.7409	52.0799	56.5032	56.2015	62.6736	65.6770	70.1963	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	120.7873	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.1702	17.0268	13.8471	10.4832	7.8363	6.6157	7.1485	9.2919	12.4716	15.8356	18.4824	19.7030	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	214.3515	216.5758	210.9707	199.0380	183.9750	169.8180	160.3603	158.1360	163.7411	175.6738	190.7368	204.8938	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	35.0787	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	-96.6298	(71)
Water heating gains (Table 5)	96.4564	94.3410	89.9483	83.9765	80.0993	74.6401	69.9999	75.9452	78.0576	84.2387	91.2181	94.3499	(72)
Total internal gains	392.2143	390.1799	377.0023	355.7338	334.1468	313.3100	299.7448	305.6093	316.5065	337.9842	362.6735	381.1828	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.1000	11.2829	0.6300	0.7000	0.7700	27.9305	(75)
Southeast	8.1000	36.7938	0.6300	0.7000	0.7700	91.0819	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	119.0124	211.9995	314.7094	431.2447	520.7308	533.5484	507.4964	438.2005	354.6665	240.9489	144.2389	100.7566	(83)
Total gains	511.2267	602.1794	691.7117	786.9784	854.8776	846.8584	807.2412	743.8098	671.1730	578.9331	506.9124	481.9394	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.8628	52.9871	53.1094	53.6918	53.8021	54.3220	54.3220	54.4193	54.1205	53.8021	53.5793	53.3483	
alpha	4.5242	4.5325	4.5406	4.5795	4.5868	4.6215	4.6215	4.6280	4.6080	4.5868	4.5720	4.5566	
util living area	0.9970	0.9932	0.9825	0.9470	0.8543	0.6879	0.5258	0.5862	0.8312	0.9688	0.9938	0.9977	(86)
MIT	19.5983	19.7779	20.0686	20.4466	20.7627	20.9381	20.9857	20.9769	20.8473	20.4326	19.9458	19.5677	(87)
Th 2	19.8301	19.8325	19.8349	19.8460	19.8481	19.8578	19.8578	19.8596	19.8541	19.8481	19.8439	19.8395	(88)
util rest of house	0.9959	0.9908	0.9762	0.9271	0.8015	0.5890	0.3968	0.4536	0.7512	0.9532	0.9913	0.9969	(89)
MIT 2	17.9814	18.2446	18.6669	19.2086	19.6217	19.8183	19.8529	19.8506	19.7351	19.2009	18.4983	17.9432	(90)
Living area fraction									fLA = Living area / (4) =			0.4253	(91)
MIT	18.6690	18.8967	19.2630	19.7351	20.1069	20.2945	20.3346	20.3296	20.2081	19.7247	19.1139	18.6340	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6690	18.8967	19.2630	19.7351	20.1069	20.2945	20.3346	20.3296	20.2081	19.7247	19.1139	18.6340	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9882	0.9721	0.9248	0.8147	0.6290	0.4521	0.5104	0.7790	0.9510	0.9890	0.9957	(94)
Useful gains	508.3744	595.0810	672.4280	727.7891	696.5060	532.6387	364.9352	379.6287	522.8245	550.5850	501.3227	479.8550	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1464.7917	1423.4883	1295.0326	1087.4849	842.0470	564.9085	370.4861	389.1303	608.1933	913.9423	1208.3294	1458.0256	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	711.5745	556.6897	463.2179	258.9810	108.2825	0.0000	0.0000	0.0000	0.0000	270.3378	509.0449	727.7589	(98)
Space heating												3605.8870	(98)
Space heating per m2											(98) / (4) =	46.4676	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)
HODKINSON

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3856.5637	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	711.5745	556.6897	463.2179	258.9810	108.2825	0.0000	0.0000	0.0000	0.0000	270.3378	509.0449	727.7589	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	761.0422	595.3900	495.4202	276.9850	115.8102	0.0000	0.0000	0.0000	0.0000	289.1314	544.4330	778.3517	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	176.9994	155.5952	162.4369	144.2655	140.3989	124.0484	117.8004	131.1037	131.4488	149.6611	159.9467	172.2859	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1457	87.9247	87.4555	86.3574	84.1312	79.8000	79.8000	79.8000	79.8000	86.3731	87.6889	88.2353	(217)
Fuel for water heating, kWh/month	200.8031	176.9642	185.7367	167.0563	166.8809	155.4491	147.6196	164.2904	164.7228	173.2727	182.4025	195.2573	(219)
Water heating fuel used												2080.4555	(219)

Annual totals kWh/year		
Space heating fuel - main system	3856.5637	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	338.5518	(232)
Total delivered energy for all uses	6350.5710	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3856.5637	0.2160	833.0178	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2080.4555	0.2160	449.3784	(264)
Space and water heating			1282.3961	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	338.5518	0.5190	175.7084	(268)
Total CO2, kg/m2/year			1497.0295	(272)
Emissions per m2 for space and water heating			16.5257	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2643	(272b)
Emissions per m2 for pumps and fans			0.5016	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5257 * 1.55) + 2.2643 + 0.5016, rounded to 2 d.p.			28.3800	(273)

Appendix C

GLA Carbon Emission Reporting Spreadsheet

SAP 2012 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	505	585
After energy demand reduction	459	585
After heat network / CHP	421	585
After renewable energy	393	585

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	46	9%
Savings from heat network / CHP	38	8%
Savings from renewable energy	28	6%
Cumulative on site savings	**112**	**22%**
Annual savings from off-set payment	393	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**11,778**	-
Cash in-lieu contribution (£)	**706,709**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	707	816
After energy demand reduction	515	816
After heat network / CHP	483	816
After renewable energy	483	816

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	192	27%
Savings from heat network / CHP	32	4%
Savings from renewable energy	0	0%
Total Cumulative Savings	**224**	**32%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**248**	-
Shortfall	24	716
Cash in-lieu contribution (£)	**42,940**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	1,212		
Be lean	974	238	20%
Be clean	904	69	6%
Be green	876	28	2%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**12,494**	-

SAP10 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	443	263
After energy demand reduction	391	263
After heat network / CHP	189	263
After renewable energy	176	263

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	53	12%
Savings from heat network / CHP	202	46%
Savings from renewable energy	13	3%
Cumulative on site savings	**267**	**60%**
Annual savings from off-set payment	176	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**5,288**	-
Cash in-lieu contribution (£)	**317,270**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	364	366
After energy demand reduction	276	366
After heat network / CHP	220	366
After renewable energy	220	366

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	88	24%
Savings from heat network / CHP	56	15%
Savings from renewable energy	0	0%
Total Cumulative Savings	**144**	**40%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	127	-
Shortfall	-17	-497
Cash in-lieu contribution (£)	**-29,826**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	807		
Be lean	666	141	17%
Be clean	409	258	32%
Be green	396	13	2%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**4,791**	-

Appendix D

BRUKL Outputs – Be Lean

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Residents facilities Kiosk and Community Space

As designed

Date: Thu Jun 25 13:07:44 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.1

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	91.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	91.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	80
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	Ground floor Tesco - kiosk_W_5
Floor	0.25	0.14	0.25	Ground floor Tesco - kiosk_S_2
Roof	0.25	0.1	0.1	level 4 - circulation_R_4
Windows***, roof windows, and rooflights	2.2	1.3	1.3	Ground floor Tesco - kiosk_G_7
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Gas Boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.1	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- Heat network connection

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

2- Gas Boiler DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.017
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Ground floor Tesco - kiosk	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 1 - community use	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - WC and change rooms	-	-	0.3	-	-	-	-	-	-	-	N/A
level 4 - gym and studio	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - bar	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - cinema	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - reading meeting	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - dining	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - kitchen	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground floor Tesco - kiosk	-	120	100	1562
level 1 - community use	-	120	-	745
level 4 - WC and change rooms	-	120	-	84
level 4 - circulation	-	120	-	151
level 4 - gym and studio	-	120	-	245
level 4 - bar	-	120	100	65
level 4 - cinema	-	120	-	241
level 4 - reading meeting	120	-	-	663
level 4 - dining	-	120	110	73
level 4 - kitchen	-	120	-	109

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Ground floor Tesco - kiosk	NO (-69.1%)	NO
level 1 - community use	NO (-4.8%)	NO
level 4 - WC and change rooms	N/A	N/A
level 4 - circulation	N/A	N/A
level 4 - gym and studio	NO (-8%)	NO
level 4 - bar	N/A	N/A
level 4 - cinema	N/A	N/A
level 4 - reading meeting	NO (-54.7%)	NO
level 4 - dining	NO (-36.3%)	NO
level 4 - kitchen	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	945.1	945.1
External area [m^2]	1724.6	1724.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	4
Average conductance [W/K]	564.47	608.4
Average U-value [W/m^{2}K]	0.33	0.35
Alpha value* [%]	14.18	9.77

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
21	**A1/A2 Retail/Financial and Professional services**
8	**A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways**
11	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
20	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
40	**D2 General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	12.96	14.86
Cooling	6.46	12.91
Auxiliary	8.69	7.01
Lighting	10.89	27.54
Hot water	296.51	295.69
Equipment*	41.02	41.02
TOTAL**	**335.5**	**358**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	146.9	211.15
Primary energy* [kWh/m^2]	455.49	520.92
Total emissions [kg/m^2]	80	91.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	39.6	107.3	13	6.5	8.7	0.85	4.62	0.91	6.5
	Notional	43.8	167.3	14.9	12.9	7	0.82	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**U_{i-Typ}**	**U_{i-Min}**	**Surface where the minimum value occurs***
Wall	0.23	0.18	Ground floor Tesco - kiosk_W_5
Floor	0.2	0.1	level 4 - WC and change rooms_F_2
Roof	0.15	0.1	level 4 - circulation_R_4
Windows, roof windows, and rooflights	1.5	1.3	Ground floor Tesco - kiosk_G_7
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name | **Shell and Core**

Retail

As designed

Date: Fri Jul 03 16:05:25 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.1

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	52.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	52.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	37.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	Ground floor Tesco - lift_stair 1_W_5
Floor	0.25	0.24	0.25	Ground floor Tesco - lift_stair 1_S_2
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	Ground floor Tesco - lift_stair 1_G_6
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Heated only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Gas boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- Boiler DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0.001
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Ground floor Tesco - bakery	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - main tesco shop floor		-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - max photoshop	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - phoneshop	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - Pharmacy_opticians		-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - community room	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - CM and Cash office 1		-	-	1.5	-	-	-	-	-	0.85	0.5

Shell and core configuration

Zone	Assumed shell?
Ground floor Tesco - meat and dairy chiller	NO

Shell and core configuration

Zone	Assumed shell?
Ground floor Tesco - food bulk storage 2	NO
Ground floor Tesco - non food bulk storage 1	NO
Ground floor Tesco - food bulk storage 3	NO
Ground floor Tesco - non food bulk storage 3	NO
Ground floor Tesco - plant	NO
Ground floor Tesco - non food bulk storage	NO
Ground floor Tesco - freezer	NO
Ground floor Tesco - food bulk storage 5	NO
Ground floor Tesco - food bulk storage 1	NO
Ground floor Tesco - bakery freezer	NO
Ground floor Tesco - food bulk storage	NO
Ground floor Tesco - lift_stair 1	NO
Ground floor Tesco - BOH corridor 1	NO
Ground floor Tesco - lobby	NO
Ground floor Tesco - lift_stair 7	NO
Ground floor Tesco - cleaners rooms	NO
Ground floor Tesco - bakery	NO
Ground floor Tesco - lift_stair 4	NO
Ground floor Tesco - lift_stair 2	NO
Ground floor Tesco - lift_stair 8	NO
Ground floor Tesco - lift_stair 5	NO
Ground floor Tesco - lift_stair 6	NO
Ground floor Tesco - B.W.S storage	NO
Ground floor Tesco - lift_stair	NO
Ground floor Tesco - main tesco shop floor	NO
Ground floor Tesco - max photoshop	NO
Ground floor Tesco - phoneshop	NO
Ground floor Tesco - Pharmacy_opticians	NO
Ground floor Tesco - community room	NO
Ground floor Tesco - CM and Cash office 1	NO
level 2 - Tesco Accommodation 1	NO
level 2 - Tesco Accommodation	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground floor Tesco - meat and dairy chiller	80	-	-	137
Ground floor Tesco - food bulk storage 2	80	-	-	167
Ground floor Tesco - non food bulk storage 1	80	-	-	156
Ground floor Tesco - food bulk storage 3	80	-	-	105
Ground floor Tesco - non food bulk storage 3	80	-	-	147
Ground floor Tesco - plant	100	-	-	1840
Ground floor Tesco - non food bulk storage	80	-	-	240
Ground floor Tesco - freezer	80	-	-	59
Ground floor Tesco - food bulk storage 5	80	-	-	86

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Ground floor Tesco - food bulk storage 1	80	-	-	35
Ground floor Tesco - bakery freezer	80	-	-	38
Ground floor Tesco - food bulk storage	80	-	-	103
Ground floor Tesco - lift_stair 1	-	100	-	71
Ground floor Tesco - BOH corridor 1	-	80	-	813
Ground floor Tesco - lobby	-	80	-	283
Ground floor Tesco - lift_stair 7	-	80	-	141
Ground floor Tesco - cleaners rooms	80	-	-	27
Ground floor Tesco - bakery	-	80	-	1717
Ground floor Tesco - lift_stair 4	-	80	-	115
Ground floor Tesco - lift_stair 2	-	80	-	64
Ground floor Tesco - lift_stair 8	-	80	-	96
Ground floor Tesco - lift_stair 5	-	80	-	58
Ground floor Tesco - lift_stair 6	-	80	-	64
Ground floor Tesco - B.W.S storage	80	-	-	31
Ground floor Tesco - lift_stair	-	80	-	81
Ground floor Tesco - main tesco shop floor	-	80	75	65295
Ground floor Tesco - max photoshop	-	80	75	553
Ground floor Tesco - phoneshop	-	80	75	553
Ground floor Tesco - Pharmacy_opticians	-	80	75	1395
Ground floor Tesco - community room	-	80	-	319
Ground floor Tesco - CM and Cash office 1	80	-	-	2857
level 2 - Tesco Accommodation 1	-	80	-	319
level 2 - Tesco Accommodation	-	80	-	331

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Ground floor Tesco - main tesco shop floor	NO (-30%)	NO
Ground floor Tesco - max photoshop	N/A	N/A
Ground floor Tesco - phoneshop	N/A	N/A
Ground floor Tesco - Pharmacy_opticians	N/A	N/A
Ground floor Tesco - community room	N/A	N/A
Ground floor Tesco - CM and Cash office 1	N/A	N/A
level 2 - Tesco Accommodation 1	N/A	N/A
level 2 - Tesco Accommodation	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	9443.5	9443.5
External area [m^2]	17002.1	17002.1
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	4214.39	4003.75
Average U-value [W/m^2K]	0.25	0.24
Alpha value* [%]	4.73	5.79

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
96	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
4	**Residential spaces**
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	6.53	7.67
Cooling	33.67	49.06
Auxiliary	5.33	2.85
Lighting	29.26	48.06
Hot water	2.09	2.12
Equipment*	162.44	162.44
TOTAL**	**76.88**	**109.77**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	563.22	687.07
Primary energy* [kWh/m^2]	220.08	311.21
Total emissions [kg/m^2]	37.3	52.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	102.5	2.3	0	0	0	0	0	0	0
	Notional	106.5	4	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Natural Gas										
	Actual	212.2	100.5	72.6	0	5.3	0.81	0	0.91	0
	Notional	221.4	98.8	75.1	0	2.7	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	1.8	705	0.6	46	6.7	0.85	4.26	0.91	6
	Notional	5.4	868.1	1.8	67	3.6	0.82	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.18	Ground floor Tesco - lift_stair 1_W_5
Floor	0.2	0.1	level 2 - Tesco Accommodation 1_F_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.3	Ground floor Tesco - lift_stair 1_G_6
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
m³/(h.m²) at 50 Pa	5	5

Appendix E

BRUKL Outputs – Be Clean

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Retail

As designed

Date: Fri Jul 03 16:03:23 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.1

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	52.4
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	52.4
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	36.6
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	Ground floor Tesco - lift_stair 1_W_5
Floor	0.25	0.24	0.25	Ground floor Tesco - lift_stair 1_S_2
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	Ground floor Tesco - lift_stair 1_G_6
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Heated only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.2	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.2	4	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Boiler DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0.001
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Ground floor Tesco - bakery	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - main tesco shop floor	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - max photoshop	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - phoneshop	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - Pharmacy_opticians	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - community room	-	-	-	1.5	-	-	-	-	-	0.85	0.5
Ground floor Tesco - CM and Cash office 1	-	-	-	1.5	-	-	-	-	-	0.85	0.5

Shell and core configuration

Zone	Assumed shell?
Ground floor Tesco - meat and dairy chiller	NO

Shell and core configuration

Zone	Assumed shell?
Ground floor Tesco - food bulk storage 2	NO
Ground floor Tesco - non food bulk storage 1	NO
Ground floor Tesco - food bulk storage 3	NO
Ground floor Tesco - non food bulk storage 3	NO
Ground floor Tesco - plant	NO
Ground floor Tesco - non food bulk storage	NO
Ground floor Tesco - freezer	NO
Ground floor Tesco - food bulk storage 5	NO
Ground floor Tesco - food bulk storage 1	NO
Ground floor Tesco - bakery freezer	NO
Ground floor Tesco - food bulk storage	NO
Ground floor Tesco - lift_stair 1	NO
Ground floor Tesco - BOH corridor 1	NO
Ground floor Tesco - lobby	NO
Ground floor Tesco - lift_stair 7	NO
Ground floor Tesco - cleaners rooms	NO
Ground floor Tesco - bakery	NO
Ground floor Tesco - lift_stair 4	NO
Ground floor Tesco - lift_stair 2	NO
Ground floor Tesco - lift_stair 8	NO
Ground floor Tesco - lift_stair 5	NO
Ground floor Tesco - lift_stair 6	NO
Ground floor Tesco - B.W.S storage	NO
Ground floor Tesco - lift_stair	NO
Ground floor Tesco - main tesco shop floor	NO
Ground floor Tesco - max photoshop	NO
Ground floor Tesco - phoneshop	NO
Ground floor Tesco - Pharmacy_opticians	NO
Ground floor Tesco - community room	NO
Ground floor Tesco - CM and Cash office 1	NO
level 2 - Tesco Accommodation 1	NO
level 2 - Tesco Accommodation	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Ground floor Tesco - meat and dairy chiller	80	-	-	137
Ground floor Tesco - food bulk storage 2	80	-	-	167
Ground floor Tesco - non food bulk storage 1	80	-	-	156
Ground floor Tesco - food bulk storage 3	80	-	-	105
Ground floor Tesco - non food bulk storage 3	80	-	-	147
Ground floor Tesco - plant	100	-	-	1840
Ground floor Tesco - non food bulk storage	80	-	-	240
Ground floor Tesco - freezer	80	-	-	59
Ground floor Tesco - food bulk storage 5	80	-	-	86

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Ground floor Tesco - food bulk storage 1	80	-	-	35
Ground floor Tesco - bakery freezer	80	-	-	38
Ground floor Tesco - food bulk storage	80	-	-	103
Ground floor Tesco - lift_stair 1	-	100	-	71
Ground floor Tesco - BOH corridor 1	-	80	-	813
Ground floor Tesco - lobby	-	80	-	283
Ground floor Tesco - lift_stair 7	-	80	-	141
Ground floor Tesco - cleaners rooms	80	-	-	27
Ground floor Tesco - bakery	-	80	-	1717
Ground floor Tesco - lift_stair 4	-	80	-	115
Ground floor Tesco - lift_stair 2	-	80	-	64
Ground floor Tesco - lift_stair 8	-	80	-	96
Ground floor Tesco - lift_stair 5	-	80	-	58
Ground floor Tesco - lift_stair 6	-	80	-	64
Ground floor Tesco - B.W.S storage	80	-	-	31
Ground floor Tesco - lift_stair	-	80	-	81
Ground floor Tesco - main tesco shop floor	-	80	75	65295
Ground floor Tesco - max photoshop	-	80	75	553
Ground floor Tesco - phoneshop	-	80	75	553
Ground floor Tesco - Pharmacy_opticians	-	80	75	1395
Ground floor Tesco - community room	-	80	-	319
Ground floor Tesco - CM and Cash office 1	80	-	-	2857
level 2 - Tesco Accommodation 1	-	80	-	319
level 2 - Tesco Accommodation	-	80	-	331

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Ground floor Tesco - main tesco shop floor	NO (-30%)	NO
Ground floor Tesco - max photoshop	N/A	N/A
Ground floor Tesco - phoneshop	N/A	N/A
Ground floor Tesco - Pharmacy_opticians	N/A	N/A
Ground floor Tesco - community room	N/A	N/A
Ground floor Tesco - CM and Cash office 1	N/A	N/A
level 2 - Tesco Accommodation 1	N/A	N/A
level 2 - Tesco Accommodation	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	9443.5	9443.5
External area [m^2]	17002.1	17002.1
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	4214.39	4003.75
Average U-value [W/m^2K]	0.25	0.24
Alpha value* [%]	4.73	5.79

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
96	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
4	**Residential spaces**
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	1.42	2.59
Cooling	33.67	49.06
Auxiliary	5.33	2.85
Lighting	29.26	48.06
Hot water	2.07	2.12
Equipment*	162.44	162.44
TOTAL**	**71.74**	**104.68**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	563.22	687.07
Primary energy* [kWh/m^2]	216.43	309.59
Total emissions [kg/m^2]	36.6	52.4

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	102.5	2.3	0	0	0	0	0	0	0
	Notional	106.5	4	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Natural Gas										
	Actual	212.2	100.5	15.7	0	5.3	3.75	0	4.2	0
	Notional	221.4	98.8	25.3	0	2.7	2.43	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	1.8	705	0.1	46	6.7	3.91	4.26	4.2	6
	Notional	5.4	868.1	0.6	67	3.6	2.43	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	Ground floor Tesco - lift_stair 1_W_5
Floor	0.2	0.1	level 2 - Tesco Accommodation 1_F_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.3	Ground floor Tesco - lift_stair 1_G_6
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Residents facilities Kiosk and Community Space

As designed

Date: Mon Nov 23 17:06:20 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.7

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	77
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	77
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	55.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	"Ground floor Tesco - kiosk_W_5"
Floor	0.25	0.14	0.25	"Ground floor Tesco - kiosk_S_2"
Roof	0.25	0.1	0.1	"level 4 - circulation_R_4"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"Ground floor Tesco - kiosk_G_7"
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.4	4.1	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Heat pump DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Ground floor Tesco - kiosk	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 1 - community use	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - WC and change rooms	-	-	0.3	-	-	-	-	-	-	-	N/A
level 4 - gym and studio	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - bar	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - cinema	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - reading meeting	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - dining	-	-	-	1.3	-	-	-	-	-	0.85	0.5
level 4 - kitchen	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W] Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Ground floor Tesco - kiosk	-	120	100	1562
level 1 - community use	-	120	-	745

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
level 4 - WC and change rooms	-	120	-	84
level 4 - circulation	-	120	-	151
level 4 - gym and studio	-	120	-	245
level 4 - bar	-	120	100	65
level 4 - cinema	-	120	-	241
level 4 - reading meeting	120	-	-	663
level 4 - dining	-	120	110	73
level 4 - kitchen	-	120	-	109

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Ground floor Tesco - kiosk	NO (-69.1%)	NO
level 1 - community use	NO (-4.8%)	NO
level 4 - WC and change rooms	N/A	N/A
level 4 - circulation	N/A	N/A
level 4 - gym and studio	NO (-8%)	NO
level 4 - bar	N/A	N/A
level 4 - cinema	N/A	N/A
level 4 - reading meeting	NO (-54.7%)	NO
level 4 - dining	NO (-36.3%)	NO
level 4 - kitchen	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	945.1	945.1
External area [m²]	1724.6	1724.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	4
Average conductance [W/K]	564.47	608.4
Average U-value [W/m²K]	0.33	0.35
Alpha value* [%]	14.18	9.77

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
21	**A1/A2 Retail/Financial and Professional services**
8	**A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways**
11	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
20	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
40	**D2 General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.47	5.01
Cooling	6.46	12.91
Auxiliary	8.69	7.01
Lighting	10.89	27.54
Hot water	79.36	99.66
Equipment*	41.02	41.02
TOTAL**	**108.87**	**152.12**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	146.9	211.15
Primary energy* [kWh/m²]	325.86	455.34
Total emissions [kg/m²]	55.1	77

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	39.6	107.3	3.5	6.5	8.7	3.17	4.62	3.4	6.5
	Notional	43.8	167.3	5	12.9	7	2.43	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	"Ground floor Tesco - kiosk_W_5"
Floor	0.2	0.1	"level 4 - WC and change rooms_F_2"
Roof	0.15	0.1	"level 4 - circulation_R_4"
Windows, roof windows, and rooflights	1.5	1.3	"Ground floor Tesco - kiosk_G_7"
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

Appendix F

Dynamic Overheating Assessment Report

HODKINSON

St Edward Homes Limited

Syon Gardens, Homebase Brentford Site

Dynamic Overheating Assessment

Final

Chiara Fratter
BArch, MSc (Hons), CEng MCIBSE

September 2020

DOCUMENT CONTROL RECORD
REPORT STATUS: FINAL

Version	Date	Reason for issue	Author	Checked by	Approved for Issue by Project Manager
v.1	05.02.2020	Draft	CFR	KP	CS
v.2	10.07.2020	Final Draft	CFR	KP	CFR pp CS
V.3	23.07.2020	Final	CFR	KP	CS
v. 4	30.07.2020	Final (minor update)	CFR	KP	CS
v. 5	31.07.2020	Final	CFR	KP	CS
v.7-8	09.09.2020	Final (minor update)	CFR	KP	DS

ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost effective solutions that respond to increasing demands for quality and construction efficiency.

This report has been prepared by Hodkinson Consultancy using all reasonable skill, care and diligence and using evidence supplied by the design team, client and where relevant through desktop research.

Hodkinson Consultancy can accept no responsibility for misinformation or inaccurate information supplied by any third party as part of this assessment.

Executive Summary

This report details the methodology and findings of a study into the overheating risk of nine representative units and one typical corridor (as representative of typical units across the development) in support of the Full Planning Application of the Homebase Brentford site, by St Edward Homes Limited, in the London Borough of Hounslow. The analysis was undertaken with the use of dynamic thermal modelling.

As standard practice homes have been selected for the overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. Among those there are homes which are more likely to present a risk of overheating as well as a variety of other homes with a lower risk of overheating.

The analysis has been undertaken in the line with the Chartered Institution of Building Services Engineers (CIBSE) TM59 overheating guidance along with Intend to Publish London Plan (2019) Policy SI14 (*Managing Heat Risk*) cooling hierarchy and London Borough of Hounslow requirements (Policy CC2 *Urban Design and Architecture*).

For the purposes of this report, it is assumed that homes will utilise openable windows as the primary means of ventilation, with a background mechanical ventilation system. External noise levels as well as air quality impact has been considered in developing the overheating strategy. Air quality deemed to be within acceptable levels and allows the use of openable windows (ES Chapter, Buro Happold) while the ventilation strategy has been designed to limit the occupants' exposure to external noise.

The proposed ventilation strategy introduces window openings during unoccupied hours for living rooms exposed to high noise risk and outside sleeping hours for bedrooms, in conjunction with a variety of passive design measures. These measures include reduced glazing ratio, raised window sill height, solar control glazing, the use of external overhang in the form of balconies to reduce the amount of heat entering the buildings as well as using landscaping to provide additional shade and background mechanical ventilation to assist natural ventilation are proposed in line with the Cooling Hierarchy.

The risk of corridor overheating has been assessed to determine the comfort conditions within the proposed development's communal areas. Communal corridors will benefit from an environmental ventilation system which will act as the primary means of ventilation.

This report demonstrates that the proposed development has incorporated as many passive design solutions as feasible following the cooling hierarchy and effectively accounting for noise constraints to reduce the risk of overheating.

St. Edward Homes Limited will continue their assessment and thermal modelling through detailed design with the objective of determining a passive design solution that mitigates for overheating risk. They are committed to working with the architect and energy consultant to ensure the scheme achieves an appropriate balance for energy performance whilst also mitigating for noise and overheating.

All homes and the communal corridor tested demonstrate that the risk of overheating has been minimised as far as practicable based on the London Plan Cooling Hierarchy and CIBSE TM59:2017 criteria. The results were based on some key design features as shown in Table i.

Table i: Key design features

Cooling hierarchy	Proposed Measures	Discussion
1. Energy efficient design	Highly efficient building fabric and air tightness standards.	*As per planning Energy Statement.*
2. Reduce the amount of heat entering the building	G-value: 0.40	*Note that a low g-value reduces the solar gains, therefore assists in the mitigation of overheating. However, it has implications on energy demand, fabric energy efficiency and internal daylight levels and has therefore been optimised to be kept as high as possible.*
	External shading: Balcony overhangs were included in the modelling as in design proposals. Glazing Ratio closer to 35% by providing raised window sill and use of spandrel panels.	*External shading is considered one of the most effective methods for solar control and overheating mitigation.* *Glazing ratio calculated to provide enough natural ventilation and good daylight levels.*
3. Manage the heat	A 250 mm concrete slab between the floors has been modelled; the thermal mass of which will help reduce the risk of overheating.	
4. Natural ventilation	**High risk noise façade (the majority of the units)** Windows assumed open during unoccupied hours for living areas and outside sleeping hours for bedrooms to limit the exposure to noise constraints. **Medium risk noise facades (units facing the internal courtyard)** Windows assumed open during occupied hours for living areas (as the external daytime noise is lower in the façade facing inside the scheme) and outside sleeping hours for bedrooms to limit the exposure to noise constraints.	*Windows were open, when internal temperature exceeds 22°C and when external temperature is lower than the internal temperature.*
6. Additional passive design measures	Use of the landscaping and massing arrangement to provide additional shade across blocks whilst minimise the impact on daylight and sunlight.	*Incorporating vegetation can offer local shadings and cooling effects as well as health and well-being benefit.*
5. Mechanical measures	**Mechanical ventilation:** Dwellings: Mechanical ventilation to achieve at least 1.0 ACH (ranging from 35.4 l/s up to a maximum of 58.2 l/s)	*A mechanical ventilation with heat recovery system being capable of delivering beyond minimum Part F ventilation rates.*
	Communal corridors to achieve at least 1.0 ach.	

Table i: Key design features		
Cooling hierarchy	**Proposed Measures**	**Discussion**
6. Active cooling	Active cooling is not included in the baseline assessment.	

CONTENTS

1. INTRODUCTION

Site and Context

1.1 The Homebase Site is a rectangular plot of land located on the corner of Syon Lane and the Great West Road at Gillette Corner. It has an area of approximately 1.4 ha, as shown in Figure 1.

1.2 The site is developed with a large Homebase store (4,180sqm) and associated surface car parking and under-croft car parking (295 spaces). The Homebase store comprises of a large industrial style shed with metal cladding. The building is effectively two storeys high with a central pylon to the front.

Figure 1: Site Location (Source: St Edward Client Brief, 2019).

1.3 The site is bound by the A4 Great West Road to the north, and Syon Lane to the south-west. There is a car showroom to the east, and a service road, Syon Gate Way which extends along the south-eastern boundary, and further along is the railway line.

1.4 The site is 400 metres from the nearest small neighbourhood centre at 1-9A Spur Road and 142-156 London Road which south-east of the Tesco Osterley Site. St Johns Road Neighbourhood Centre is around 2km to the south of the site. The site is also approximately 900 metres west from Brentford Town Centre and over 2km east from Hounslow Town Centre.

1.5 The site has a public transport accessibility rating of PTAL 2/3. The southern part of the site falls into a PTAL 3 area, due to its proximity to bus services on London Road.

1.6 Syon Lane station is in Zone 4. National Rail services direct to London Waterloo, Richmond and Weybridge. Furthermore, Osterley Station provides access to the Piccadilly line service and is within 2km of the site.

1.7 There are bus stops directly adjacent to the site on A4 Great West Road and Syon Lane within 50m. Bus stops on London Road, adjacent to Syon Park are also accessible to the site, approximately 600m south of the site.

1.8 The site is well served by bus routes with seven regular bus services within walking distance of the site. The H28 bus route runs along Syon Lane and stops and turns around at Tesco Osterley. The H91 can be accessed from the A4 at bus stops K/C respectively and serves destinations which include Chiswick, Hammersmith and Hounslow Town Centre.

1.9 The immediate surrounding area comprises a mix of uses including commercial and residential development. There are semi-detached houses on the western side of Syon Lane, opposite the site. Along the Great West Road there is a variety of commercial and industrial uses as well as some residential uses, and further along Syon Lane the uses are predominantly residential.

Proposed Development

1.10 The Proposed Development is described as follows:

“Full planning application for the demolition of existing building and car park and erection of buildings to provide residential units, a replacement retail foodstore, with additional commercial, business and service space, and a flexible community space, and ancillary plant, access, servicing and car parking, landscaping and associated works”

1.11 Figure 2 below illustrates the proposed site layout.

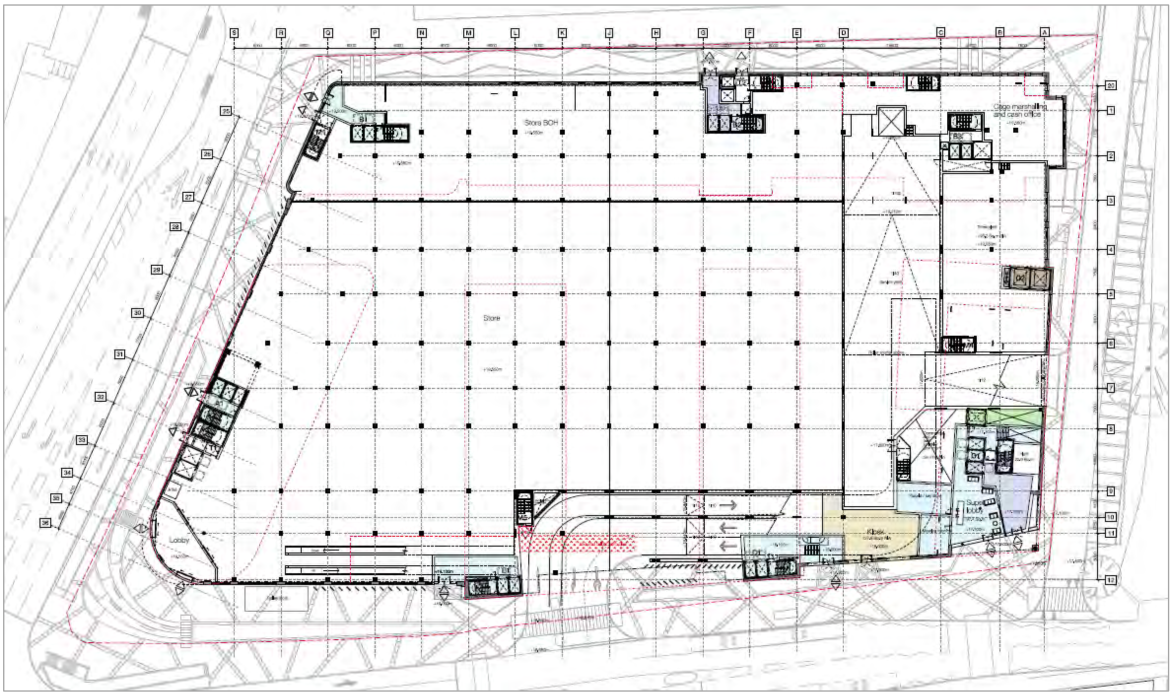

Figure 2: Ground Floor level (Patel Taylor 28.08.2020)

Overheating and Thermal Comfort

1.12 Maintaining thermal comfort conditions in the face of increased temperatures is one of the biggest challenges designers need to address. The main objective will be to achieve thermal comfort without recourse to conventional air-conditioning systems, where typical technologies involve greenhouse gas emissions.

1.13 Dynamic thermal simulations (using Design Builder Software v.6) have been carried out for representative homes and their associated communal corridors. The purpose of the study was to determine whether the selected homes and communal corridors present a risk of overheating. Appropriate mitigation measures were recommended to mitigate overheating risk and ensure that comfortable thermal conditions are provided during occupied hours.

2. REQUIRED STANDARDS

Regional Policy: Intend to Publish London Plan (2019)

2.1 In line with the London Borough of Hounslow's Local Plan, planning applications should also demonstrate implementation of the Intend to Publish London Plan.

2.2 The Draft London Plan was published for consultation on 1st December 2017, and consultation took place on this document up to 2nd March 2018. The Greater London Authority is now reviewing consultation feedback, with a view to formally publishing the document in the 2020.

2.3 While the document is not yet adopted, it remains a material consideration in planning terms although it can currently be afforded only limited weight. Once adopted, it will inform decisions on London's development between 2019 and 2041.

2.4 The following relevant policies from the **Intend to Publish London Plan** (2019) and the **London Environmental Strategy** (2018) have been considered in the development of the measures that mitigate the risk of overheating of the proposed Homebase Brentford scheme.

2.5 **Policy SI4: Managing heat risk** sets out the cooling hierarchy approach and it states that:

Major development proposals should demonstrate through an energy strategy how they will reduce the potential for overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) minimise internal heat generation through energy efficient design;

2) reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls;

3) manage the heat within the building through exposed internal thermal mass and high ceilings;

4) provide passive ventilation;

5) provide mechanical ventilation; and

6) provide active cooling systems.

*[..] Occupant behaviour will also have an impact on overheating risk. The Mayor's **London Environment Strategy** sets out further detail on actions being taken to address this.*

Passive ventilation should be prioritised, taking into account external noise and air quality in determining the most appropriate solution. The increased use of air conditioning systems is not *desirable as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce. Future district heating networks are expected to be supplied with heat from waste heat sources such as building cooling systems.*

2.6 **Policy SI4 Managing heat risk** outlines that the CIBSE TM59 methodology and the TM49 weather datasets should be used for the modelling. Further guidance are provided within the GLA'S Energy Planning Guidance (October 2018).

Local Policy: Hounslow Local Plan (2015-2030)

2.7 The London Borough of Hounslow Local Plan adopted in September 2015 shapes the spatial strategy for the next 15 years. Although the Local Plan doesn't set out a specific overheating requirement, the following policy has been considered for the proposed development.

2.8 **Policy CC2: Urban Design and Architecture** states that proposal development is expected to be designed to:

(p) Promote low carbon design and incorporate energy efficiency measures that are themselves well integrated into the design and appearance of the development.

(r) Be designed to mitigate noise and air quality issues which significantly affect parts of the borough;

2.9 This policy also outlines that a good use of practice guidance such as By Design, the Urban Design Compendium and the Mayor's Housing Design Guide, Mayor's Housing SPD and building for life assessment should be employed.

CIBSE TM59 (2017)

2.10 The recently updated GLA Guidance on Preparing Energy Assessments (October 2018), identifies CIBSE TM59 guidance as the most appropriate methodology for the assessment of the overheating risk in homes.

2.11 The latest criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in the **CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017)**. CIBSE TM59 is based on **CIBSE TM52** and **CIBSE Guide A** guidance documents and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

2.12 The new **CIBSE TM59** guidance suggests that **the following two criteria must be met** in order to demonstrate compliance:

- **(i)** For living rooms, kitchens and bedrooms: The indoor operative temperature should not exceed the threshold comfort temperature by 1 K or more for more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance);

- **(ii)** For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

2.13 Whilst there is no specific standard to meet for communal corridor areas, as they are only transient spaces, their performance has been assessed against the CIBSE TM59 (2017) guidance, which suggests a **threshold temperature of 28°C for less than 3% of the total annual hours**. Exceedance of that threshold should be flagged as a significant overheating risk.

3. MODELLING APPROACH

Methodology

3.1 The dynamic thermal modelling software Design Builder has been used to set up the model and run dynamic simulations for overheating risk.

3.2 The performance of the homes has been assessed under the CIBSE TM59 guidance and the adaptive thermal comfort model for a primarily natural ventilated scenario.

3.3 It is best practice assess representative homes with different layouts, sizes, orientation and window openability restrictions, located across the development. The selection of the homes for overheating risk assessment was based among other parameters on the design characteristics:

> Units with large glazed areas;

> Single aspect homes lacking cross ventilation and double aspects units;

> Upper floor homes lacking beneficial shading effect from balcony overhangs above them and mid-floor levels shaded by balconies;

> Homes located in different orientations, floor levels and across all the building blocks of the development.

> Window openability constraints due to external noise was also accounted;

3.4 A representative communal corridor, associated with the assessed homes, was also selected for overheating assessment.

3.5 The location and the internal layouts of the homes and corridor selected for assessment are presented in Appendix F1. The homes were modelled based on design freeze drawings received by Patel Taylor on 20/07/2020.

Site External Weather Conditions

3.6 External temperatures and incidental solar gains are greatest during summer months, coinciding with periods of lower wind speeds. However, solar altitude is highest during summer months, increasing the effects of façade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.

3.7 The effects of external conditions are vital in an overheating assessment as they influence:

> Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);

> Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

3.8 The GLA guidance on preparing Energy Assessments (2018), refers to the CIBSE TM59's methodology and TM49 on the use of weather files for overheating assessments:

"It is expected that the CIBSE compliance criteria is met for the DSY1 weather scenario.

Additional testing should be undertaken using the 2020 versions of the following more extreme design weather years:

> DSY2 – 2003: a year with a very intense single warm spell.

> DSY3 – 1976: a year with a prolonged period of sustained warmth.

It is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files.

Where the CIBSE compliance criteria is not met for a particular weather file the applicant must demonstrate that the risk of overheating has been reduced as far as practical and that all passive measures have been explored, including reduced glazing and increased external shading. The applicant should also outline a strategy for residents to cope in extreme weather events, e.g. use of fans.

3.9 CIBSE Design Summer Year weather data for London Heathrow (representative of urban areas outside the Central Activity Zone) has been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59.

3.10 The results for the extreme DSY2 and DSY3 weather files that were additionally tested are presented in Appendix F2. It should be noted that compliance with extreme summer scenarios (DSY2 and DSY3) is not mandatory and can be challenging (CIBSE TM59). However, adaptation measures for the more extreme weather scenarios are proposed to help occupants cope in the event of extreme weather conditions.

Model Geometry and Local Shading

3.11 Overshadowing from the building blocks was taken into account during simulations based on the model geometry and the site orientation.

3.12 Solar control forms an integral part of overheating mitigation strategies. External shading devices in the form of balconies are applied in most of the blocks across the development as part of the design proposals. These were incorporated in the simulation model and are shown in Figure 4.

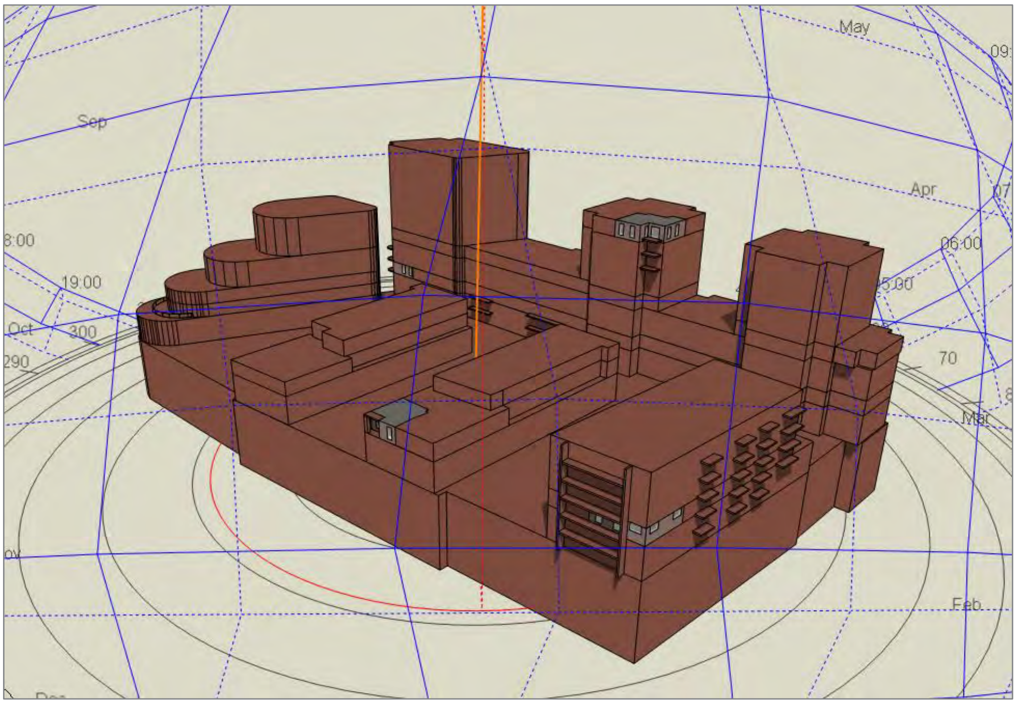

Figure 4: Sun path diagram (Source: Design builder simulation model, 21t June 12:00).

3.13 Horizontal shading devices such as balconies and overhangs are more efficient when applied in south oriented facades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

Design Modelling Inputs for Homes

3.14 Table 1 provides the modelling inputs that have been set up in the dynamic thermal simulation, in line with Energy Statement SAP calculation inputs. CIBSE TM59 guidance has been used for all occupancy rates and internal heat gain assumptions which will contribute to the risk of overheating.

Table 1: Dynamic Thermal Modelling Design Assumptions			
Data Input			**Discussion**
Weather data	**Location**	CIBSE Heathrow Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario.	*Geographically closest and most representative industry-standard CIBSE weather data file.*
		Additional DSY2, DSY3 were tested to demonstrate performance under extreme weather conditions (Appendix F2).	
	External walls	0.18W/m^2/K	*As per planning Energy Statement.*

Table 1: Dynamic Thermal Modelling Design Assumptions			
Data Input			**Discussion**
Building Fabric Construction details	**Flat roof**	0.10 W/m²/K	*Thermally massive construction assumed. As per Planning Energy Statement.*
	Ground floor	0.10 W/m²K	*Thermally massive construction assumed. As per Planning Energy Statement.*
	Ceilings/floors	Assumed to be adiabatic between adjacent floors.	*These are thermally massive and will add to the thermal capacity of the building. Since there are units above and below all simulated units heat loss through ceilings and floors was assumed to be zero (adiabatic).*
	Party walls between units	Fully filled and sealed.	*Walls adjacent to other units were assumed to be lightweight partitions. Adjacent units were included in the dynamic simulation calculations.*
	Partitions within units	Steel-stud partitions.	*Assumed thicknesses as per Studio Egret West Architects planning drawings.*
	Internal doors	Internal doors: 0.90m width	*Measured from Patel Taylor planning drawings.*
Windows	**Windows and Glazed Doors**	U value 1.4 W/m²K	*Double Glazed, Low-E in line with the Energy Statement.*
		G-value: 0.4	*Specified to reduce solar gains and mitigate against overheating while limiting negative effect on the energy demand and internal daylight levels.*
	Shading	External shading in form of projected and recessed balconies (Blocks B,C,D,E) and overhangs (Block A).	*These elements will provide some solar shading as the sun tracks around the building.*
	Reveal depth	External reveal: 225 mm	Measured from Patel Taylor planning drawings.
		Internal reveal: 225 mm	

Table 1: Dynamic Thermal Modelling Design Assumptions			
Data Input			**Discussion**
Ventilation and infiltration	**Air Tightness**	3m³/hr-m²@50 pascals	*As per planning Energy Statement*
	Natural Ventilation	Internal doors are only open during the day (07:00-22:00).	*Windows and balcony doors are assumed with restrictors (100mm) during the night-time for security. Window openability has been based on external noise level (Appendix F3).*
		For façades with high noise constraints windows should be left open when rooms are unoccupied as well as outside of sleeping hours for bedrooms.	
		For façades with medium noise constraints (units facing inside the scheme) are assumed to have windows open during occupied hours in living rooms and outside sleeping hours for bedrooms.	
		A detailed window opening schedule can be found in Section 4 of this document. Windows are open when internal temperature exceeds 22°C and external temperature is lower than indoor temperature.	
	Mechanical ventilation	**Dwellings:** Mechanical ventilation to achieve 1.0 ach (depending on unit size up to a maximum of 58.2l/s).	*Assumption made based on a mechanical ventilation with heat recovery system that will achieve ventilation rates beyond the minimum Part F requirements.*
		Corridors: Ventilation rate of 1.0 ach required.	*These will ensure internal comfortable levels will be ensure throughout the year.*
Comfort cooling	**Active cooling**	Active cooling is not included in the baseline assessment.	

Internal Gains for Homes

3.15 The following internal gains assumptions (Table 2) have been made in the dynamic thermal simulations in line with the CIBSE TM59 guidance.

Table 2: Occupancy & Equipment gains (CIBSE TM59)		
Unit/room type	**Occupancy**	**Equipment Load**
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Utility cupboard	N/A	10W on 24/7
Corridors	**Occupancy**	**Equipment Load**
Ceiling Void	N/A	17. 1 W
Mechanical Riser	N/A	175.4 W
Lighting Corridor	N/A	0.0 W (PIR sensors)

Design Modelling Inputs for Communal Corridors

3.16 The same building fabric details and glazing properties used in the modelling of the selected homes (Table 1) were used in the modelling of the corridors. The baseline assumptions were based on information received by Buro Happold and involve:

> Low temperature ambient loop system: Flow and return temperatures such as 60^{0}C and 30^{0}C respectively;

> Pipework insulation type (phenolic insulation with thermal conductivity of 0.025 W/mK minimum 0.04mm thickness) and pipes thickness (40 diameter); and

> Passive infrared sensor (PIR) for lightings (assumed as standard practice).

3.17 The estimated heat losses generated by the heating network have been calculated using the information above and are presented in more detail in Appendix F4.

4. AIR QUALITY, NOISE AND VENTILATION STRATEGY

4.1 Results from the acoustic assessment on the noise levels at façades undertaken by Buro Happold across the Homebase Brentford development, indicated that the proposed scheme will be affected by high noise levels throughout the day (>62dB) and night (>55dB). This is mainly caused by the proximity to the A4 Great West Road to the north, the Syon Lane railway to the south and aircraft noise from Heathrow airport nearby.

4.2 With windows open, internal noise levels are likely to rise above the recommended acceptable levels during both daytime and night-time periods. However, apartments with windows closed all the time often exceed the acceptable thermal comfort criteria. Natural ventilation is shown to have a significant effect in reducing internal temperatures and limit overheating to acceptable levels as well as removing high concentrations of pollutants and water vapour.

4.3 For the purposes of this report, it is assumed that units will utilise openable windows as the primary means of ventilation, with a background mechanical ventilation system assisting in the overheating risk mitigation.

4.4 The assumption has been made that windows will be kept open when the rooms are not occupied to limit the occupant exposure to noise nuisance in conjunction with additional passive measures as described in Section 5. Windows open during unoccupied time such as living room window open at night allow bedroom windows to remain closed when occupants are sleeping is proposed.

4.5 Two noise risk levels have been identified by the acoustic assessment. Facades exposed to high noise levels due to the combination of external noise sources (such as traffic road, aircrafts and railway) both during the day and night times. Facades facing inwards are expected to benefit from a calmer noise environment during the daytime when the aircraft nuisance is less frequent.

4.6 This report suggests overheating mitigation strategies for each risk level. For facades with high noise constraints (façade coloured in red in Figures 6 and 8), windows in living rooms should be left open mainly when these are unoccupied and for bedrooms outside of sleeping hours (22:00-07:00). Conversely, for facades categorised at medium noise risk (facades coloured in amber in Figure 6), windows in living rooms can be left open during occupied hours (9:00-22:00) as the daytime noise level are lower in the inside part of the scheme.

4.7 Table 3 below presents the natural ventilation strategy proposed to mitigate the noise constraints and to meet the overheating criteria set out in CIBSE TM59:2017. The strategy is based on the results of the acoustic modelling conducted by Buro Happold (Figures 5 and 7) and indicating the noise risk category based on the AVO Guidance in the overleaf mark-up plans (Figures 6 and 8).

Table 3: Proposed natural ventilation strategy			
Façade Zone	**Room**	**Occupied Hours**	**Ventilation strategy**
High Risk Noise Category (Units marked up in red)	**Living room**	09:00-22:00	Windows open during limited occupied and unoccupied hours (7:00-19:00 and 23:00-7:00). Windows on restrictors (100mm) during the night-time for security.
	Bedroom	24/7 (sleeping hours 22:00-07:00)	Windows open outside sleeping hours (07:00-22:00).
Medium Risk Noise Category Façades (Units marked up in yellow)	**Living room**	09:00-22:00	Windows open during occupied hours (09:00 - 22:00) and throughout the night. Windows open on restrictors (100mm) during the night-time for security.
	Bedroom	24/7 (sleeping hours 22:00-07:00)	Windows open outside sleeping hours (07:00-22:00).
Natural ventilation from windows is recommended when internal temperature exceeds 22°C (Tindoor> 22°C) and external temperature is lower than the internal temperature: ($T_{outdoor} < T_{indoor}$).			

4.8 The potential air quality impacts on future site users have also assessed within the Environmental Statement (ES Chapter produced by Buro Happold, July 2020) states *that pollutant concentrations at the residential unit locations across the Site have been predicted for the opening year and compared against air quality objectives. All residential units meet long and short-term air quality limits in the most realistic operational scenario, and as such openable windows are acceptable at all residential units*. Therefore, it is deemed acceptable to use window openings to mitigate overheating.

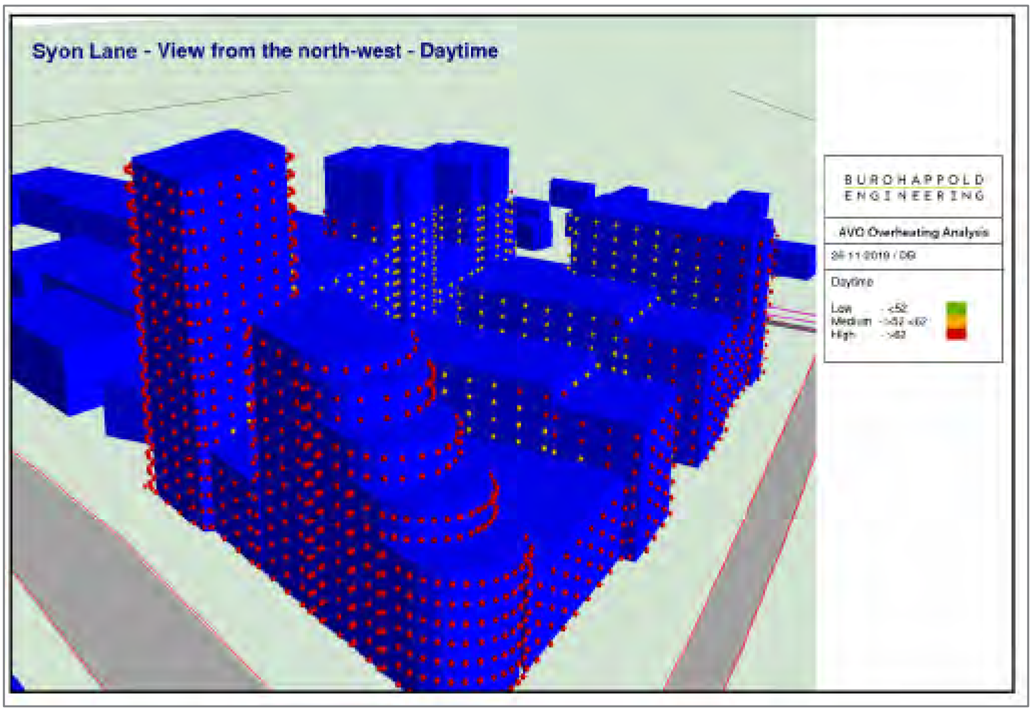

Figure 5: AVO overheating model noise level on the north-west façade during daytime (Source: Buro Happold Noise Design Note)

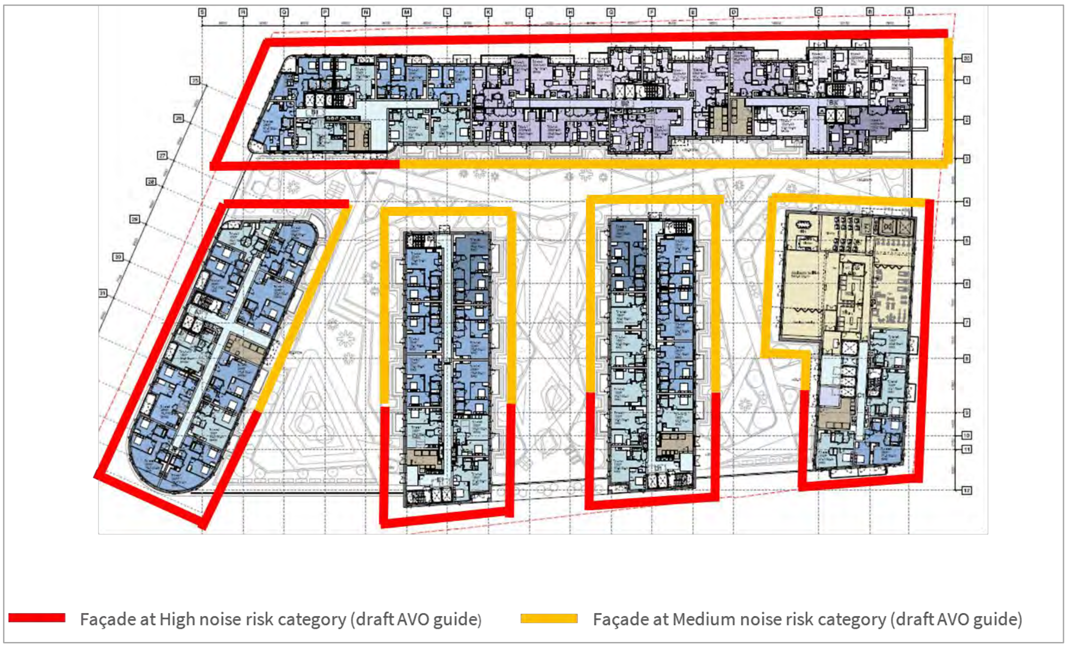

Figure 6: Natural ventilation strategy mark-up daytime based on noise modelling results.

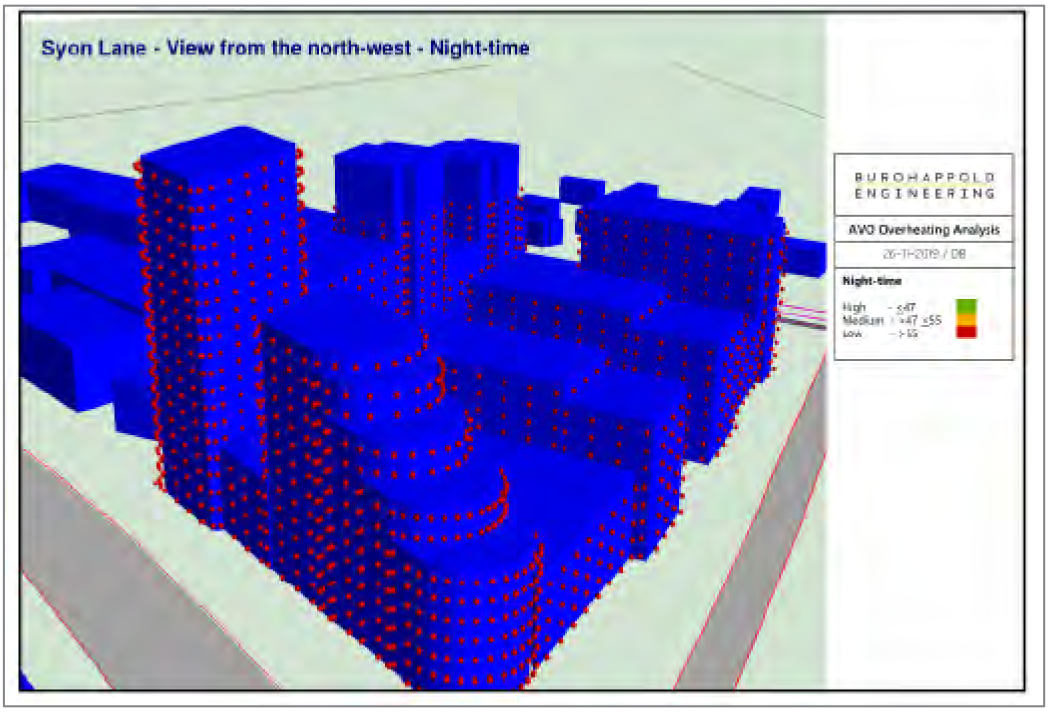

Figure 7: AVO overheating model noise level on the north-west façade during night-time (Source: Buro Happold Noise Design Note)

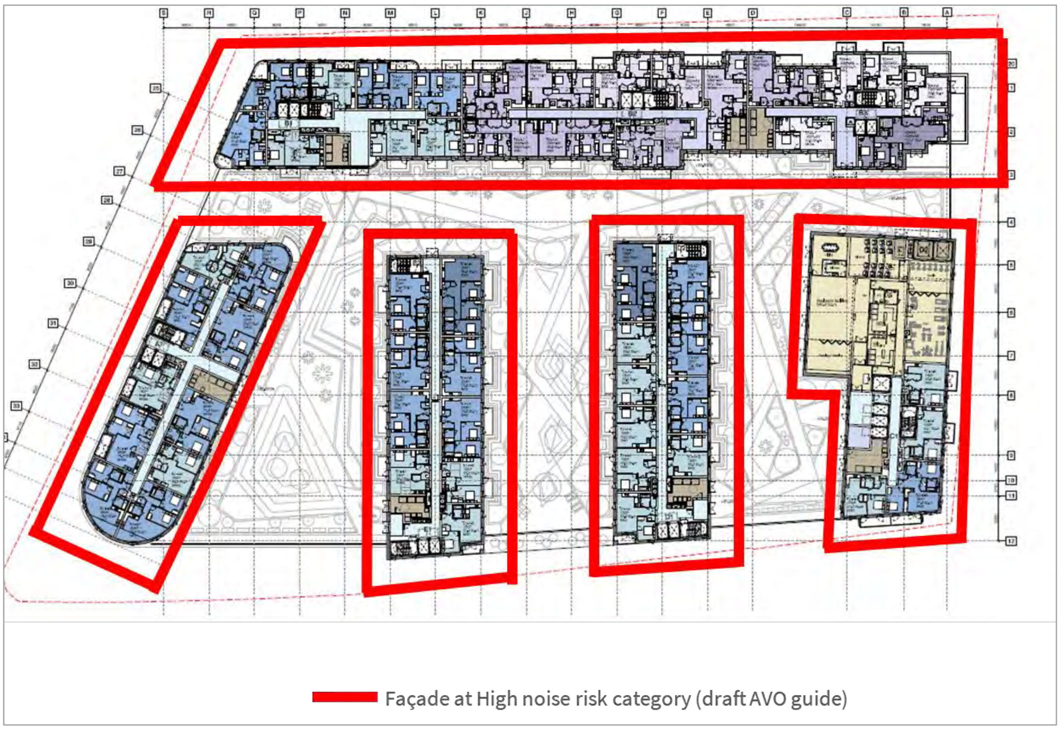

Figure 8: Natural ventilation strategy mark-up night-time based on noise modelling results.

5. PASSIVE DESIGN DEVELOPMENT

5.1 This Section outlines the design evolution as well as internal discussions that the design team undertook to ensure that the risk of overheating is mitigated and balanced with other environmental aspects such as external noise constraints and daylight provision.

5.2 It is important to identify potential overheating risk early on in the design process and then incorporate as many suitable design measures as possible. Particularly when the site presents external constraints such as noise that can limit the use of openings to ventilate the habitable spaces.

5.3 Early-stage dynamic thermal modelling was carried out on a sample of units and used to implement the final design of the proposed Homebase Brentford scheme to balance thermal and acoustical comfort along with natural daylight provision at the same time.

5.4 As part of the design process the opportunity to implement passive design measures was regularly discussed during several overheating workshops arranged through the course of the concept design in the presented of the architect, the sustainability, the acoustician, and the daylight consultants.

Initial overheating modelling comparing different windows sizing

5.5 The risk of overheating has been investigated from an early design stage and several iterations/strategies and design solutions were investigated to limit occupant exposure to external noise and ensure acceptable indoor temperatures at the same time.

5.6 The impact of glazing sizing was identified in addressing the risk of overheating from the outset. A windows exercise study demonstrated how reducing window dimensions will improve overheating performance. Three window types were tested on a sample of units starting from full height window compared with narrow (Figure 9, Opt. 1) and wider windows (Figure 9, Opt. 2). The results were then used by the design team to guide elevation proposal which has evolved into a mixture of windows tailored at block level to balance acceptable daylight levels as well as overheating risk considering noise constraints context.

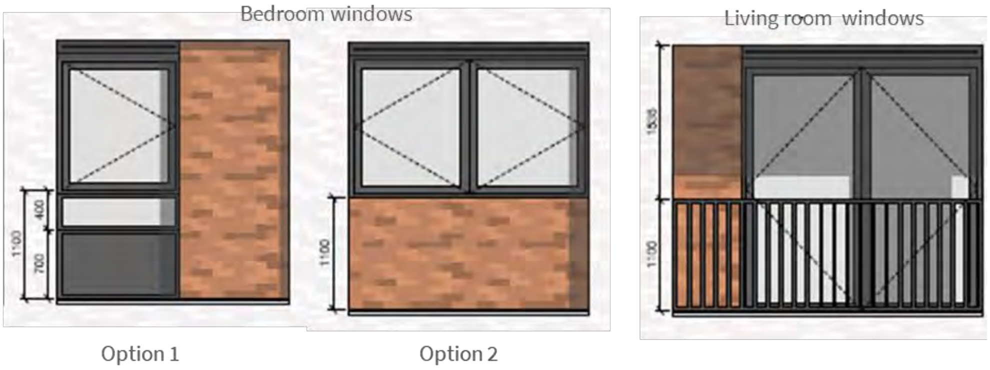

Figure 9. Windows design options tested (Source: Patel Taylor Architects architectural drawings received on 19.08.2019 (initial design) and 10.12.2019).

Raised sill height

5.7 In order to maintain good daylight levels and provide windows sufficient large to ventilated spaces, it is useful to note that glazing located below 700mm do not contribute usefully to daylight levels in a room but the still contribute to winter heat losses and summer overheating risk.

5.8 Raised sill height has been investigated through dynamic modelling on bedrooms which were identified at higher risk of overheating. Table 4 shows the results of the TM59 assessment carried out during the design process on a sample unit and demonstrate that raising sill height by substituting a lower pane with an opaque panel is an effective measure to reduce overheating.

5.9 This measure was then incorporated on all bedrooms on the north-east façade of Blocks B1, B2 and B3.

Table 4. TM59 Overheating Results DSY1 2020s - (external noise constraints)

		Full-height windows in bedrooms			Raised sill height in bedrooms		
Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)
B2.4.2 2Bed	Bedroom	0.00	104.83	71.8	0.00	83.17	50.2
	LDK	0.00	N/A	-	0.00	N/A	-
	Single Bedroom	0.00	55.17	22.2	0.00	58.17	25.2

Balconies arrangement

5.10 External shading devices can significantly reduce the solar gains entering a space. This can take the form of different features such as shutters or overhangs and they can be fixed or moveable.

5.11 Balconies are a good example of external shading that are more effective when used on southern facades. The proposed development made use of balconies as the predominant form of external shading. However, as highlighted above balconies are less effective on west and east facades thus it has been investigated the impact of moving balconies between kitchen/living rooms and adjacent bedroom to provide some shade to both rooms.

5.12 The results of the interim thermal modelling indicate that moving balconies across kitchen/living room spaces and bedrooms provide thermal benefit and reduce the risk of overheating. Table 5 shows the results on two sample units in blocks E and D.

Table 5. TM59 Overheating Results DSY1 2020s - (external noise constraints)

Room		Balconies in front of kitchen/living rooms			Balconies between rooms		
		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)
E1.4.6 2Bed	Bedroom1	0.00	72.67		0.00	83.17	50.2
	Bedroom2	0.00	94.33		0.00	N/A	-
	LDK	0.00	N/A		0.00	58.17	25.2
D1.4.8 2Bed	Bedroom1	0.00	73.50	40.5	0.00	59.00	26.0
	Bedroom2	0.00	93.50	60.5	0.00	86.50	53.5
	LDK	0.00	N/A	-	0.00	N/A	

Internal layout changes

5.13 Dynamic thermal modelling tool considers multiple variables that affect thermal comfort such as external weather conditions, internal gains, thermal properties of the fabric envelope, occupancy and use of the spaces. The internal layout and the arrangement of rooms within an apartment should be considered to minimise the risk of overheating.

5.14 During the interim overheating modelling it has been demonstrated that swapping the traditional layout with kitchen/living room with a balcony access and having bedrooms instead (Figure 10) provides better results and allow bedrooms to benefit from external shading.

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Figure 10. Illustration of internal layout concept tested against overheating criteria.

Table 6 represents the improvement in the results on a corner unit on block D where the bedroom has been moved from the west façade to a south façade.

Table 6. TM59 Overheating Results DSY1 2020s - (external noise constraints)							
		Typical layout			New layout		
Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	No of hours exceed TM59 'criterion b' target (>32hours)
D1.06.1	Bedroom	0.00	117.00	84.0	0.03	61.17	28.2
	LDK	0.20	N/A	-	0	N/A	-
	Single Bed	0.11	87.00	54.0	-	-	-

Proposed passive measures

5.15 As result of all the numerous modelling carried out during the design development the proposed Homebase Brentford development has incorporated all the following passive design measures in accordance with the Cooling Hierarchy:

> Highly efficient fabric envelope and high efficiency building services heating system, lightings and appliances are proposed in all dwellings to reduce internal gains;

> High performance solar control glazing with a g-value of 0.4 is proposed for all windows across the scheme. This has been balanced out to achieve fabric energy efficiency target and natural daylight provisions;

> Glazing ratio has been maximised across the scheme and it has been reduced closer to 35% in accordance with Good Homes Alliance recommendations for mitigating overheating risk;

> Window sill height has been raised by 1100mm and the bottom pane has been substituted with an opaque panel in bedrooms on sensitive noise facades (Blocks B and C) to reduce excessive solar gains;

> Window openability has been maximised to enable natural ventilation. All windows are fitted with restrictors but the future occupants will have the freedom to unlock them to allow for more ventilation during the hottest months;

> External shading in form of balconies and overhangs have been strategically arranged across the blocks. For instance, balconies on western and eastern facades (Blocks D and E) have been shifted to provide shade to kitchen/living rooms and adjacent bedrooms at the same time. Where possible bedrooms have been located behind balconies to allow for additional shade;

> Dual-aspect units and ‘hybrid’ single aspects have been maximised across the scheme. Semi-dual units employ recessed balconies to enable one room to have windows on adjacent walls and enhance cross-ventilation;

> Planting trees and vegetation to provide a natural screen to glazed areas of the dwellings on the podium level;

> Made use of concrete structure within the floor slab which provides some thermal capacity to absorb excessive heat within the building; and

> Increased mechanical ventilation rates up to 1.0ACH to assist natural ventilation in mitigating the risk of overheating.

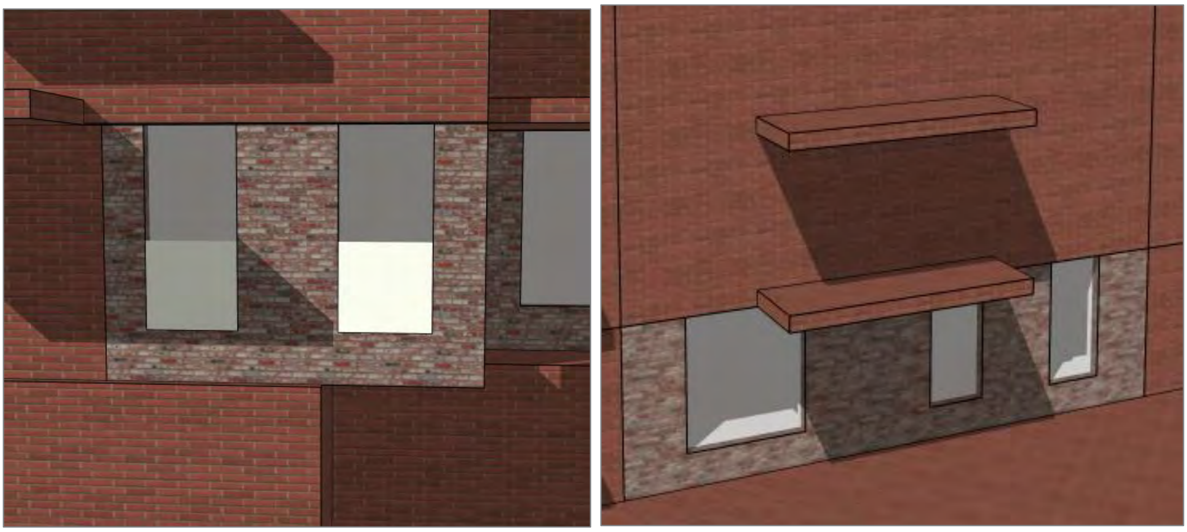

Figure 11. Left: Windows with higher sill and bottom panel on Block B. Right: shade provided by a balcony in between kitchen/living room and bedrooms in Block D (View of the model).

6. SUMMARY OF RESULTS

Dwellings

6.1 Table 7 summarises the results from dynamic thermal simulations for the buildings under the current design summer year (1989) for the Heathrow Airport weather data 2020s high emission, 50% percentile scenario, as required by TM59 in a context without noise constraints.

6.2 Results presented in Table 7 indicate that, based on windows open during occupied time in kitchen/living rooms (9:00-22:00) and bedrooms (24/7) all assessed rooms meet the TM59 criteria and achieve acceptable internal comfort levels far below the TM59 threshold targets. As a demonstration that the proposed development has identified robust passive design measures which effectively mitigate the risk of overheating.

Table 7: Overheating Results DSY1 2020s (Non-external noise constraints)

Orientation & Dwelling type	Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
			% hours of overheating	Hours of overheating	
E - Single Aspect	A1.4.4	Bedroom 1	0.00	20.33	Pass
		Bedroom 2	0.00	18.33	Pass
		LDK	0.00	N/A	Pass
SW – Single Aspect	B1.4.4	Bedroom	0.00	21.33	Pass
		LDK	0.04	N/A	Pass
N/S – Dual Aspect	B2.4.2	Bedroom 1	0.00	6.00	Pass
		Bedroom 2	0.00	9.00	Pass
		LDK	0.00	N/A	Pass
E -Dual Aspect	B3.4.5	Bedroom	0.00	11.83	Pass
		LDK	0.17	N/A	Pass
E – Single Aspect	D1.4.8	Bedroom 1	0.00	17.17	Pass
		Bedroom 2	0.00	16.33	Pass
		LDK	0.00	N/A	Pass
E - Single Aspect	E1.4.6	Bedroom 1	0.00	17.83	Pass
		Bedroom 2	0.00	16.67	Pass
		LDK	0.00	N/A	Pass
W -Dual - aspect	B1.6.7	Bedroom	0.00	16.83	Pass
		Bedroom 1	0.02	13.50	Pass

Table 7: Overheating Results DSY1 2020s (Non-external noise constraints)					
Orientation & Dwelling type	Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
			% hours of overheating	Hours of overheating	
		LDK	0.44	N/A	Pass
SE -Dual aspect	B2.14.2	Bedroom1	0.05	23.67	Pass
		Bedroom2	0.00	24.83	Pass
		LDK	0.85	N/A	Pass
SE -Dual Aspect	C1.06.08	Bedroom	0.00	15.83	Pass
		Bedroom2	0.00	14.00	Pass
		LDK	0.80	N/A	Pass

6.3 In the noise context where window opening times are limited to certain hours of the day as set out in Table 3, the results of the assessment show that kitchen/ living rooms continue to meet TM59 requirements, but with windows closed for acoustic reasons there are some instances of exceedance of the bedroom overheating criteria as set out in Table 8.

6.4 Table 8 shows the results of the TM59 overheating assessment based on the assumptions within Tables 1,2 and 3, when window openability is restricted to limit the future residents' exposure to external noise with particularly attention to sensitive rooms such as bedrooms. The results indicate that bedrooms tend to slightly exceed the TM59 criterion by relatively small number of hours (average of 38hrs) equivalent to 0.4% a year during the hottest days of the summer. All kitchen/living room spaces meet TM59 criteria under a noise context.

6.5 The proposed development has incorporated as many passive design solutions as feasible following the cooling hierarchy and effectively accounting of noise constraints to reduce the risk of overheating. Despite that, there is an intention to further investigate the opportunity to mitigate the residual risk of overheating identified in the bedrooms thought additional dynamic modelling at detailed design.

Table 8: Overheating Results DSY1 2020s - TM59 (external noise constraints)						
Orientation & Dwelling type	**Room**		**TM59 Criterion A: Hours of exceedance (pass<3%)**	**TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)**	**Overall compliance with TM59**	**No of hours exceed TM59 'criterion b' target (>32hours)**
			% hours of overheating	**Hours of overheating**		
E – Single aspect	A1.4.4	Bedroom1	0.00	76.67	Fail	43.7
		Bedroom2	0.00	79.17	Fail	46.2
		LDK	0.00	N/A	Pass	-
SW – Single aspect	B1.4.4	Bedroom	0.00	82.00	Fail	49.0
		LDK	0.00	N/A	Pass	-
N/S– Dual aspect	B2.4.1	Bedroom 1	0.00	48.33	Fail	15.33
		Bedroom 2	0.00	43.17	Fail	10.17
		LDK	0.00	N/A	Pass	-
E – Dual aspect	B3.4.5	Bedroom	0.00	91.33	Fail	58.3
		LDK	0.00	N/A	Pass	-
E –single Aspect	D1.4.8	Bedroom1	0.00	55.67	Fail	22.7
		Bedroom2	0.00	66.33	Fail	33.3
		LDK	0.00	N/A	Pass	-
E –single Aspect	E1.4.6	Bedroom1	0.00	59.50	Fail	26.5
		Bedroom2	0.00	74.00	Fail	41.0
		LDK	0.00	N/A	Pass	-
W – Dual aspect	B1.6.7	Bedroom	0.00	55.17	Fail	22.2
		BedroomQ1	0.03	60.17	Fail	27.2
		LDK	0.34	N/A	Pass	-
SE – Dual aspect	B2.14.2	Bedroom1	0.01	74.67	Fail	41.7
		Bedroom2	0.00	85.17	Fail	52.2
		LDK	0.26	N/A	Pass	-
SE – Dual aspect	C1.06.08	Bedroom	0.00	75.17	Fail	42.2
		Bedroom2	0.00	57.17	Fail	24.2
		LDK	0.38	N/A	Pass	-

6.6 The more extreme weather files DSY2, DSY3 were tested additionally to this assessment and are presented in Appendix F2. Adaptation measures for the more extreme weather scenarios are proposed for the occupants to be employed to cope in extreme climate conditions.

6.7 Suggested additional measures include ceiling fans or internal fans can also create a more comfortable environment as air movement enhances the occupant's perception of thermal comfort. Window opening at night-time, if external noise is considered acceptable in the future, can also reduce the overheating risk hours significantly.

Communal Corridors

6.8 Under CIBSE TM59 (2017) guidance, the maximum recommended temperature of 28°C should not be exceeded for more than 3% of the total annual hours for the communal corridor areas.

6.9 With a mechanical extract ventilation system achieving air flow rate of at least 1.0 ach alongside the use of lower flow temperature system, within the corridor, the corridor temperatures remain below the 3% target.

6.10 Table 9 below, presents the overheating results assuming 1.0 ach mechanical extract rate when internal temperature exceeds 28ºC. The results show that the operative temperature stay far below the threshold of 28°C.

6.11 The results of the TM59 assessment in corridors demonstrate also that the use of heating system at lower temperatures in combination with a mechanical ventilation is an effective measure to mitigate risk of overheating when natural ventilation is not available.

Table 9: Overheating Results for Corridors with mechanical ventilation @ 1.0ACH

	TM59 Overheating Criterion (Temp ≤ 3% over 28°C)	Overall compliance with TM59
Corridor Block C	0.00%	Pass

6.12 Results for DSY2 and DSY3 extreme weather files presented in Appendix F2, indicate that the proposed ventilation strategy will effectively meet the target.

7. CONCLUSION

7.1 This report details the methodology and findings of a study into the overheating risk of nine representative units and one typical corridor (as representative of typical units across the development) in support of the Full Planning Application of the Homebase Brentford site, by St Edward Homes Limited, in the London Borough of Hounslow. The analysis was undertaken with the use of dynamic thermal modelling.

7.2 As standard practice homes have been selected for the overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. Among those there are homes which are more likely to present a risk of overheating as well as a variety of other homes with a lower risk of overheating.

7.3 The analysis has been undertaken in the line with the Chartered Institution of Building Services Engineers (CIBSE) TM59 overheating guidance along with Intend to Publish London Plan (2019) Policy SI14 (*Managing Heat Risk*) cooling hierarchy and London Borough of Hounslow requirements (Policy CC2 *Urban Design and Architecture*).

7.4 For the purposes of this report, it is assumed that homes will utilise openable windows as the primary means of ventilation, with a background mechanical ventilation system. External noise levels as well as air quality impact has been considered in developing the overheating strategy. Air quality deemed to be within acceptable levels and allows the use of openable windows (ES Chapter, Buro Happold) while the ventilation strategy has been designed to limit the occupants' exposure to external noise.

7.5 The proposed ventilation strategy introduces window openings during unoccupied hours for living rooms exposed to high noise risk and outside sleeping hours for bedrooms, in conjunction with a variety of passive design measures. These measures include reduced glazing ratio, raised window sill height, solar control glazing, the use of external overhang in the form of balconies to reduce the amount of heat entering the buildings as well as using landscaping to provide additional shade and background mechanical ventilation to assist natural ventilation are proposed in line with the Cooling Hierarchy.

7.6 The risk of corridor overheating has been assessed to determine the comfort conditions within the proposed development's communal areas. Communal corridors will benefit from an environmental ventilation system which will act as the primary means of ventilation.

7.7 This report demonstrates that the proposed development has incorporated as many passive design solutions as feasible following the cooling hierarchy and effectively accounting for noise constraints to reduce the risk of overheating.

7.8 St. Edward will continue their assessment and thermal modelling through detailed design with the objective of determining a passive design solution that mitigates for overheating risk. They are committed to working with the architect and energy consultant to ensure the scheme achieves an appropriate balance for energy performance whilst also mitigating for noise and overheating.

7.9 All homes and the communal corridor tested demonstrate that the risk of overheating has been minimised as far as practicable based on the London Plan Cooling Hierarchy and CIBSE TM59:2017 criteria. The results were based on some key design features as shown in Table 10.

Table 10: Key design features

Cooling hierarchy	Proposed Measures	Discussion
1. Energy efficient design	Highly efficient building fabric and air tightness standards.	*As per planning Energy Statement.*
2. Reduce the amount of heat entering the building	G-value: 0.40	*Note that a low g-value reduces the solar gains, therefore assists in the mitigation of overheating. However, it has implications on energy demand, fabric energy efficiency and internal daylight levels and has therefore been optimised to be kept as high as possible.*
	External shading: Balcony overhangs were included in the modelling as in design proposals. Glazing Ratio closer to 35% by providing raised window sill and use of spandrel panels.	*External shading is considered one of the most effective methods for solar control and overheating mitigation.* *Glazing ratio calculated to provide enough natural ventilation and good daylight levels.*
3. Manage the heat	A 250 mm concrete slab between the floors has been modelled; the thermal mass of which will help reduce the risk of overheating.	
4. Natural ventilation	**High risk noise façade (the majority of the units)** Windows assumed open during unoccupied hours for living areas and outside sleeping hours for bedrooms to limit the exposure to noise constraints. **Medium risk noise facades (units facing the internal courtyard)** Windows assumed open during occupied hours for living areas (as the external daytime noise is lower in the façade facing inside the scheme) and outside sleeping hours for bedrooms to limit the exposure to noise constraints.	*Windows were open, when internal temperature exceeds 22°C and when external temperature is lower than the internal temperature.*
6. Additional passive design measures	Use of the landscaping and massing arrangement to provide additional shade across blocks whilst minimise the impact on daylight and sunlight.	*Incorporating vegetation can offer local shadings and cooling effects as well as health and well-being benefit.*
	Mechanical ventilation:	

Table 10: Key design features

Cooling hierarchy	Proposed Measures	Discussion
5. Mechanical measures	Dwellings: Mechanical ventilation to achieve at least 1.0 ACH (ranging from 35.4 l/s up to a maximum of 58.2 l/s)	*A mechanical ventilation with heat recovery system being capable of delivering beyond minimum Part F ventilation rates.*
	Communal corridors to achieve at least 1.0 ach.	
6. Active cooling	Active cooling is not included in the baseline assessment.	

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APPENDICES

APPENDIX F1
Assessed Zones Internal Layouts

APPENDIX F2
Extreme DSY2, DSY3 Weather Scenarios

APPENDIX F3
Noise Risk Category and Acoustic Guidance

Appendix F4
Dwelling Mechanical Ventilation Rates

Appendix F5
Communal Corridor LTHW heat losses

Appendix F6
Good Homes Alliance (GHA) Overheating scoresheet

APPENDIX F1

Assessed Zones Internal Layouts

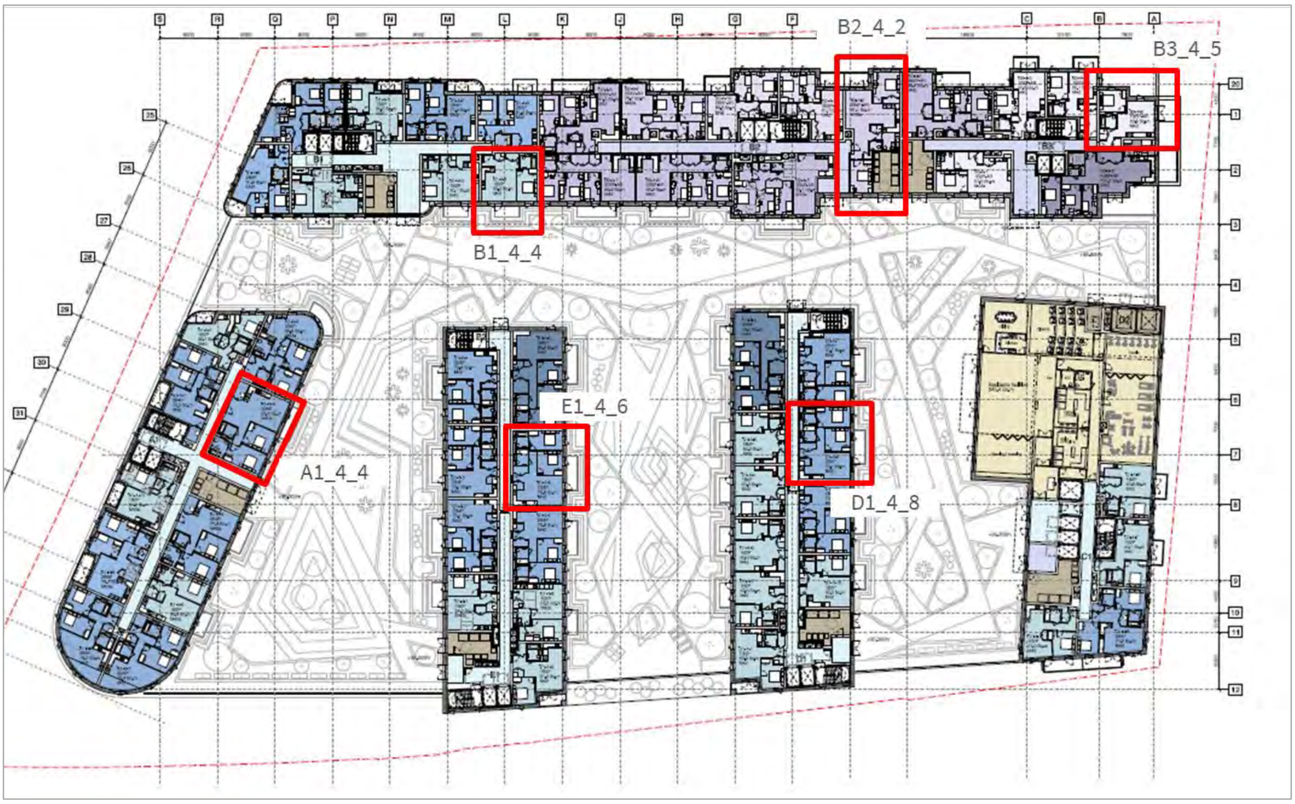

Figure F1.1: 4th floor typical floor plan indicating selected units tested (Source: Patel Taylor Architects received on 20.07.2020).

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Figure F1.2: 6th floor typical floor plan indicating two units tested (Source: Patel Taylor Architects received on 20.07.2020).

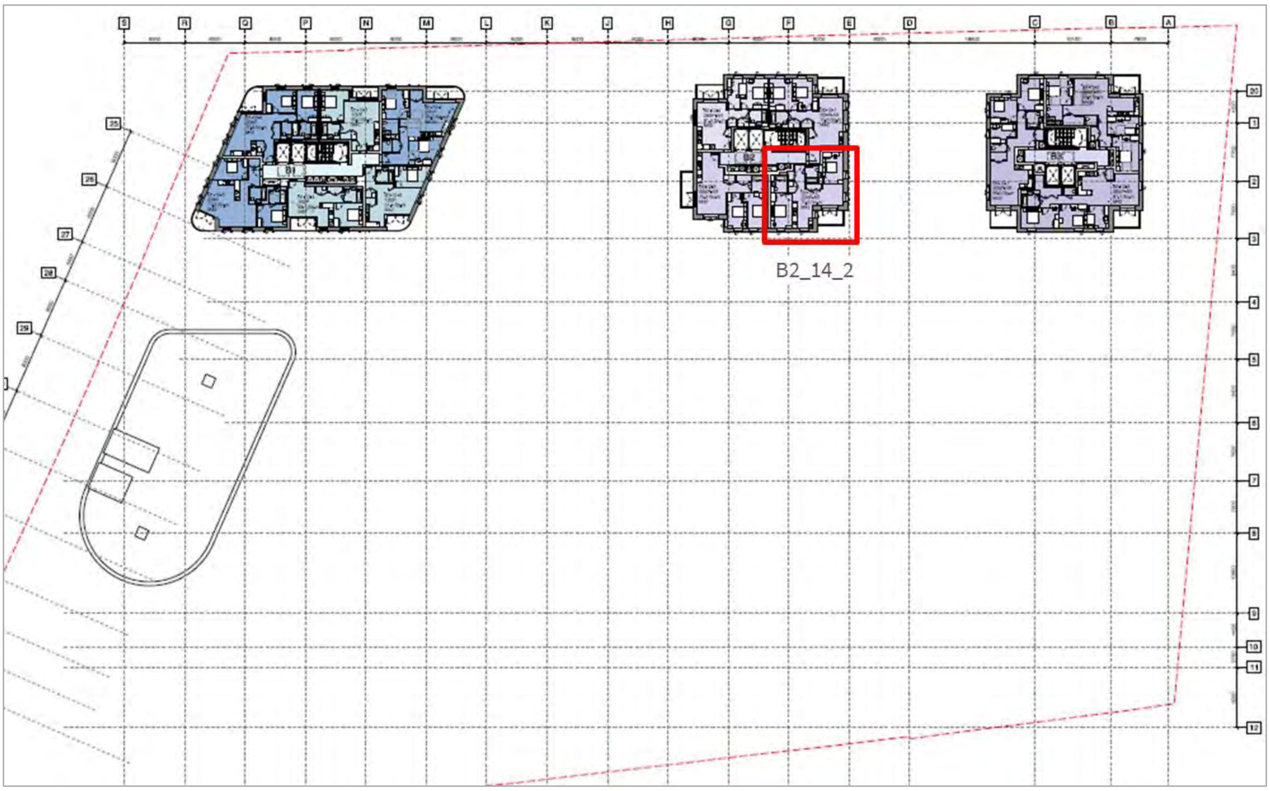

Figure F1.3: 14th floor typical floor plan indicating two units tested (Source: Patel Taylor Architects received on 20.07.2020).

APPENDIX F2
Extreme DSY2, DSY3 Weather Scenarios

Based on the CIBSE TM59 guidance, achieving compliance with the DSY1 (design summer year) file most appropriate for the site location for the 2020s, high emissions, 50% percentile scenario is mandatory.

Further weather scenarios can be tested to explore the performance of the design under extreme weather events (e.g. heatwaves and prolonged warmth). As acknowledged in the GLA guidance for preparing energy statements, meeting the criteria for the DSY2 and DSY3 weather files can be challenging and therefore where compliance criteria are not met, the assessment should demonstrate how the risk of overheating has been reduced as far as practical.

Adaptation measures for the more extreme weather scenarios are proposed so that occupants can cope in extreme climatic conditions.

Additional mitigation measures such as including high solar reflectance internal blinds (Medium solar reflectance of 50%) for all rooms as well as utilising ceiling or portable fans to create a more comfortable environment as air movement enhances the occupant's perception of thermal comfort have been tested. The results show that most of the bedrooms tend to exceed the target, while all living kitchen spaces meet the TM59 criteria in both extreme weather dataset (DSY2 and DSY3).

It should be noted that additional measures are recommendation for the future occupant and not a commitment for the applicant.

It should be noted that widows openability for the more extreme weather conditions has been based on the external noise constraints as identified in section 4 of this document. Windows have been assumed open during unoccupied time for living/kitchen space and bedrooms in the majority of the facades, while during occupied time in the living/kitchen spaces for the façade facing inwards the site as quiet noise level were identified.

The proposed ventilation system that supplies 1.00 ach to the communal corridor represents an effective solution even during more extreme weather scenarios (Tables F2.1Bb and F2.2b).

Tables F2.1 and F2.2 overleaf present the result of the recommended additional mitigation measures described above for the dwellings under more extreme scenarios (DSY2 and DSY3).

Table F2.1a: Dwelling TM59 overheating results DSY2 2020s					
Orientation & Dwelling type	**Room**		**TM59 Criterion A: Hours of exceedance (pass<3%)**	**TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)**	**Overall compliance with TM59**
			% hours of overheating	**Hours of overheating**	
E – Single aspect	A1.4.4	Bedroom1	0.17	97.33	Fail
		Bedroom2	0.04	99.67	Fail
		LDK	0.10	N/A	Pass
SW – Single aspect	B1.4.4	Bedroom	0.43	105.33	Fail
		LDK	0.73	N/A	Pass
N/S – Dual aspect	B2.4.2	Bedroom 1	0.00	74.50	Fail
		Bedroom 2	0.00	75.00	Fail
		LDK	0.00	N/A	Pass
E – Dual aspect	B3.4.5	Bedroom	0.10	103.17	Fail
		LDK	0.06	N/A	Pass
E –single Aspect	D1.4.8	Bedroom1	0.00	87.67	Fail
		Bedroom2	0.00	94.17	Fail
		LDK	0.06	N/A	Pass
E –single Aspect	E1.4.6	Bedroom1	0.00	90.00	Fail
		Bedroom2	0.00	96.83	Fail
		LDK	0.03	N/A	Pass
W – Dual aspect	B1.6.7	Bedroom	0.00	82.83	Fail
		BedroomQ1	0.08	83.83	Fail
		LDK	0.54	N/A	Pass
SE – Dual aspect	B2.14.2	Bedroom1	0.11	85.00	Fail
		Bedroom2	0.12	90.17	Fail
		LDK	0.49	N/A	Pass
SE – Dual aspect	C1.06.08	Bedroom	0.05	90.67	Fail
		Bedroom2	0.18	85.17	Fail
		LDK	1.03	N/A	Pass

Table F2.1b: Corridors TM59 overheating results - DSY 2 2020's – TM59		
Zone	TM59 Overheating Criterion (Temp ≤ 3% over 28°C)	Overall compliance with TM59
Corridor Block C – 7F	0.00%	Pass

Table F2.2a: dwelling TM59 overheating Results DSY 3 2020s					
Orientation & Dwelling type	Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
			% hours of overheating	Hours of overheating	
E – Single aspect	A1.4.4	Bedroom1	0.00	66.17	Fail
		Bedroom2	0.00	85.50	Fail
		LDK	0.00	N/A	Pass
SW – Single aspect	B1.4.4	Bedroom	0.00	79.33	Fail
		LDK	0.00	N/A	Pass
N/S– Dual aspect	B2.4.2	Bedroom 1	0.00	54.00	Fail
		Bedroom 2	0.00	51.00	Fail
		LDK	0.00	N/A	Pass
E – Dual aspect	B3.4.5	Bedroom	0.00	103.50	Fail
		LDK	0.00	N/A	Pass
E –single Aspect	D1.4.8	Bedroom1	0.00	50.67	Fail
		Bedroom2	0.00	78.17	Fail
		LDK	0.00	N/A	Pass
E –single Aspect	E1.4.6	Bedroom1	0.00	57.50	Fail
		Bedroom2	0.00	84.50	Fail
		LDK	0.00	N/A	Pass
W – Dual aspect	B1.6.7	Bedroom	0.00	63.33	Fail
		BedroomQ1	0.00	60.50	Fail
		LDK	0.73	N/A	Pass
SE – Dual aspect	B2.14.2	Bedroom1	0.00	71.00	Fail
		Bedroom2	0.00	76.00	Fail

Table F2.2a: dwelling TM59 overheating Results DSY 3 2020s					
Orientation & Dwelling type	Room		TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
			% hours of overheating	Hours of overheating	
		LDK	0.00	N/A	Pass
SE – Dual aspect	C1.06.08	Bedroom	0.00	84.33	Fail
		Bedroom2	0.00	54.33	Fail
		LDK	0.00	N/A	Pass

Table F2.2b: Corridors TM59 overheating results - DSY 3 2020's		
Zone	TM59 Overheating Criterion (Temp ≤ 3% over 28°C)	Overall compliance with TM59
Corridor Block C – 7F	0.00%	Pass

APPENDIX F3
Noise Risk category and Acoustic Guidance

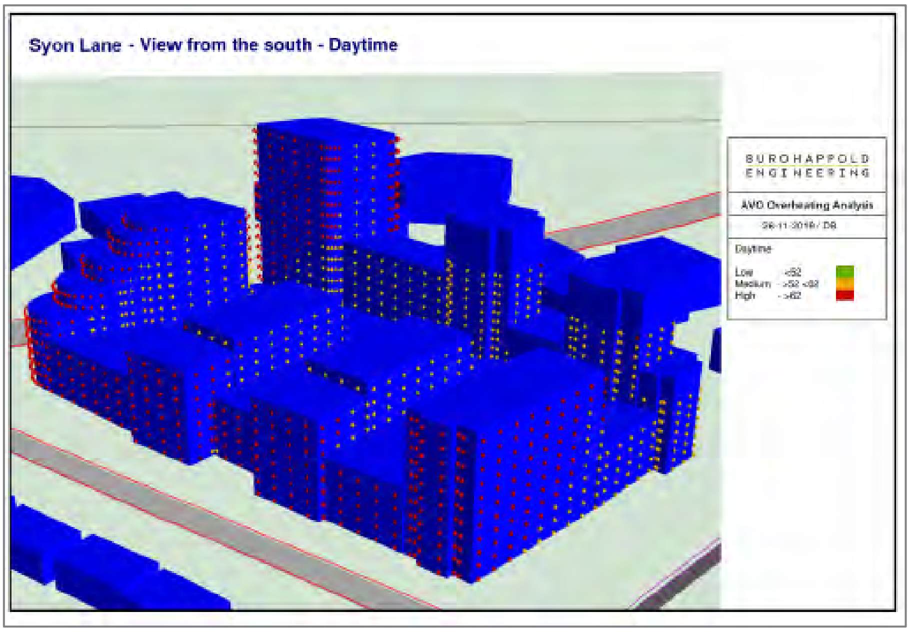

Figure F3.1: AVO overheating model noise level on the south façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

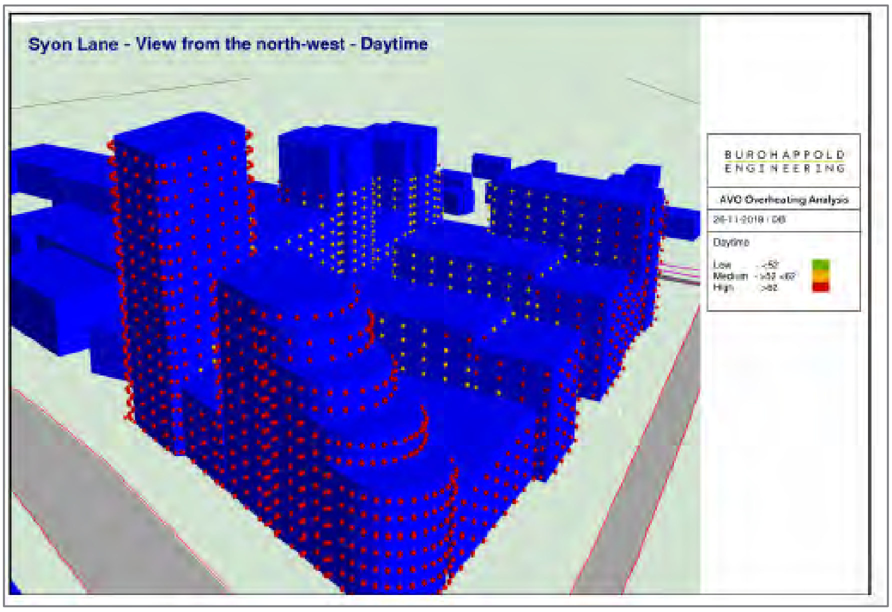

Figure F3.2: AVO overheating model noise level on the North-west façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

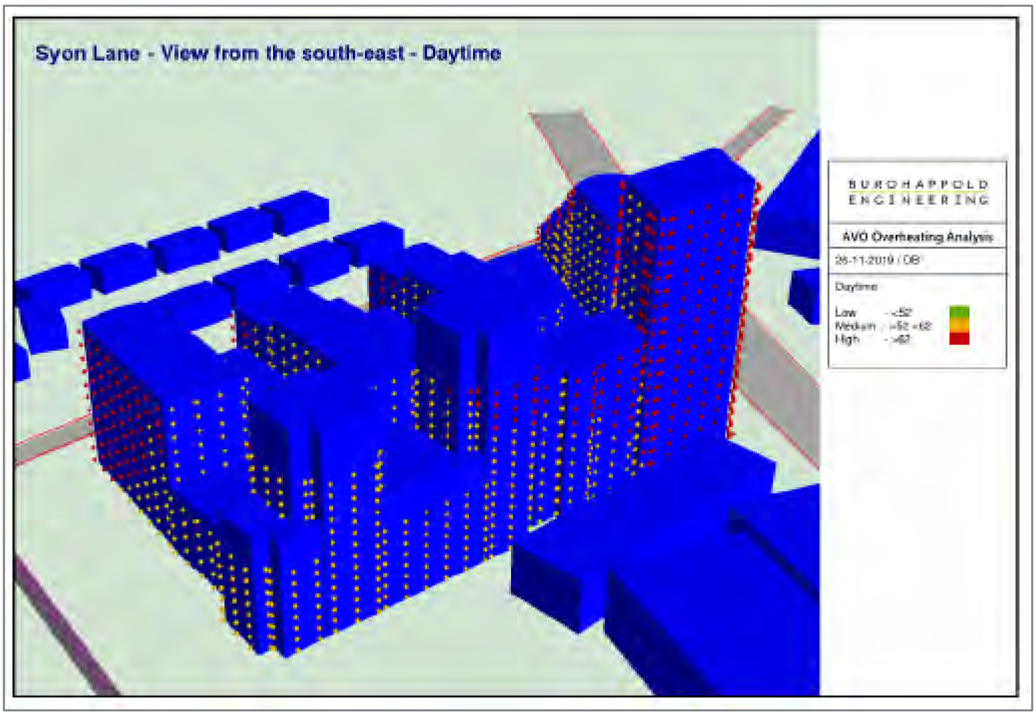

Figure F3.3: AVO overheating model noise level on the south-east façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

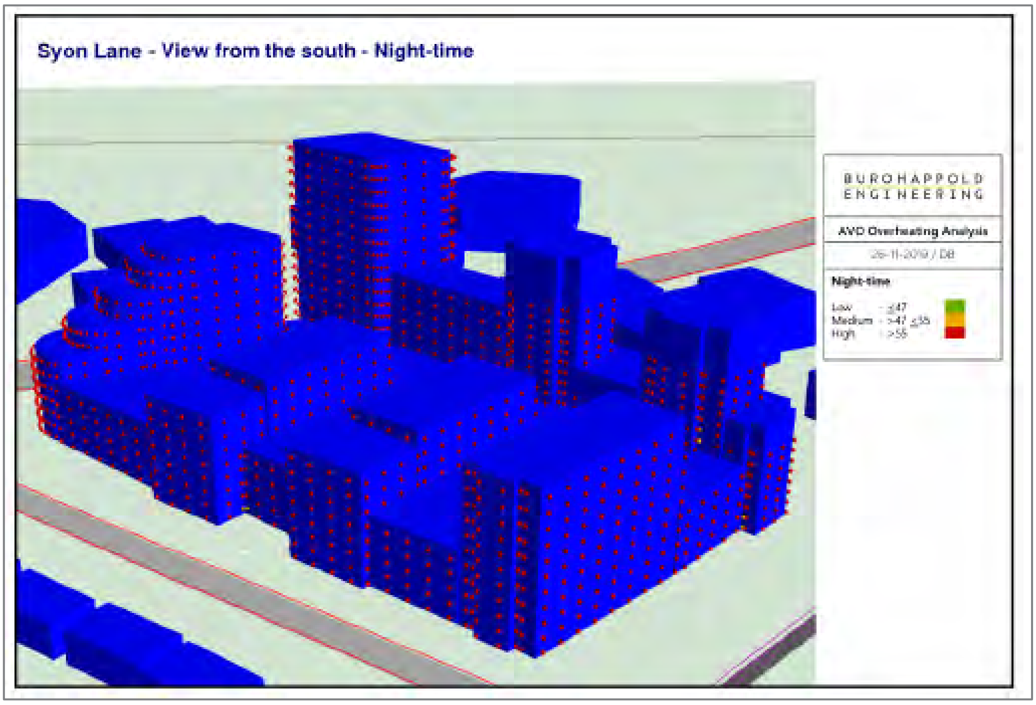

Figure F3.4: AVO overheating model noise level on the south façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

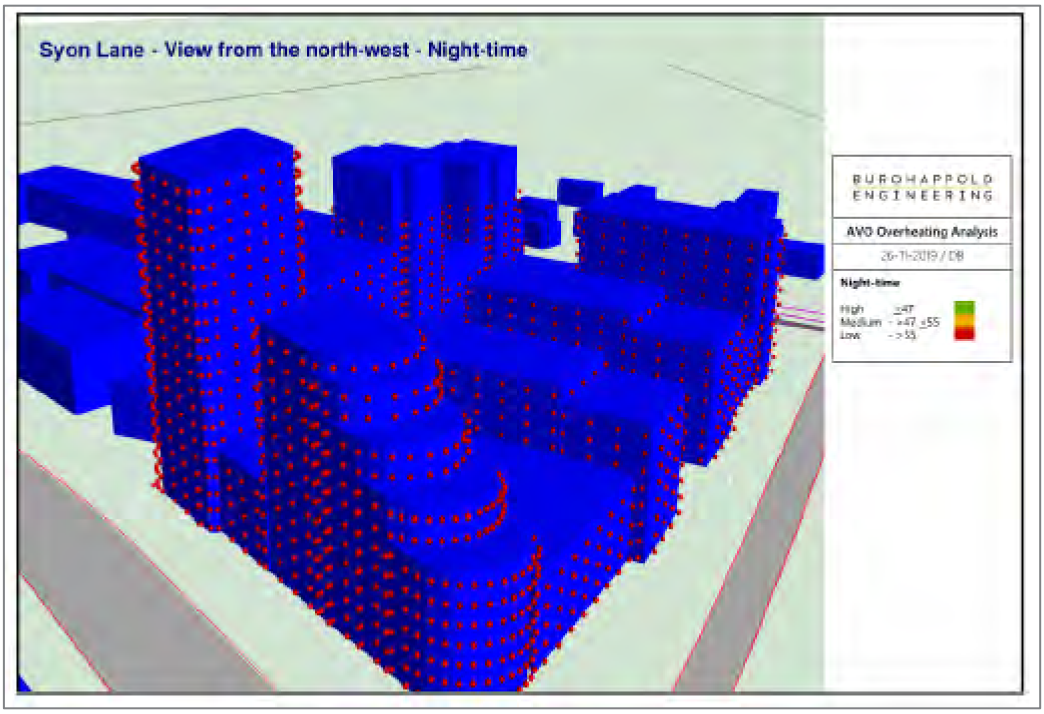

Figure F3.5: AVO overheating model noise level on the North-west façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

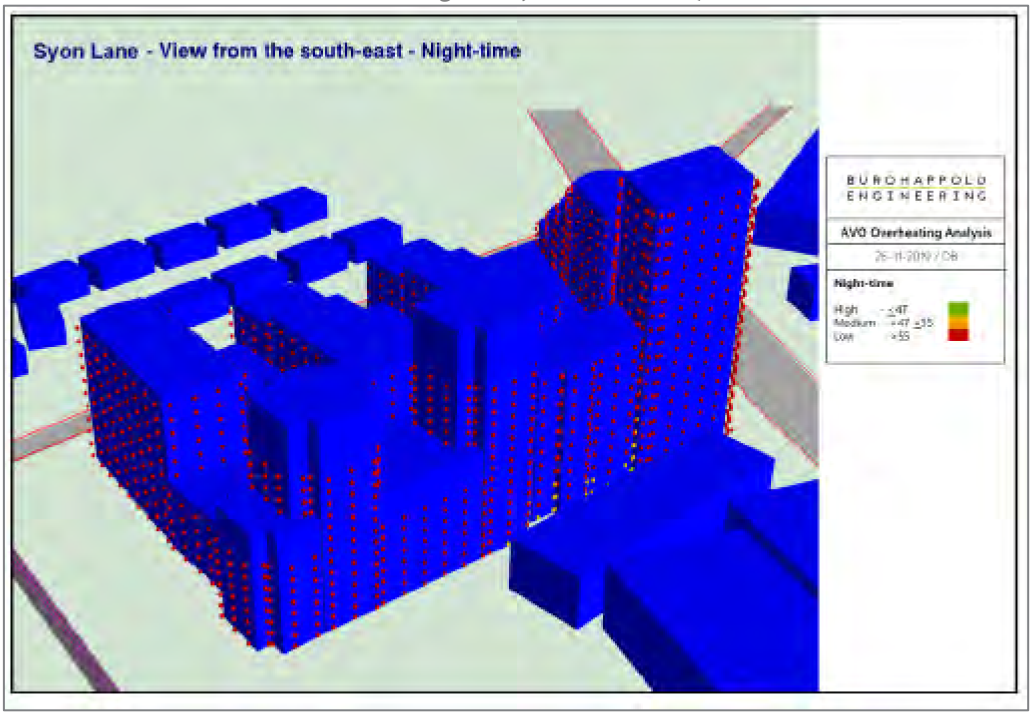

Figure F3.6: AVO overheating model noise level on the south-east façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

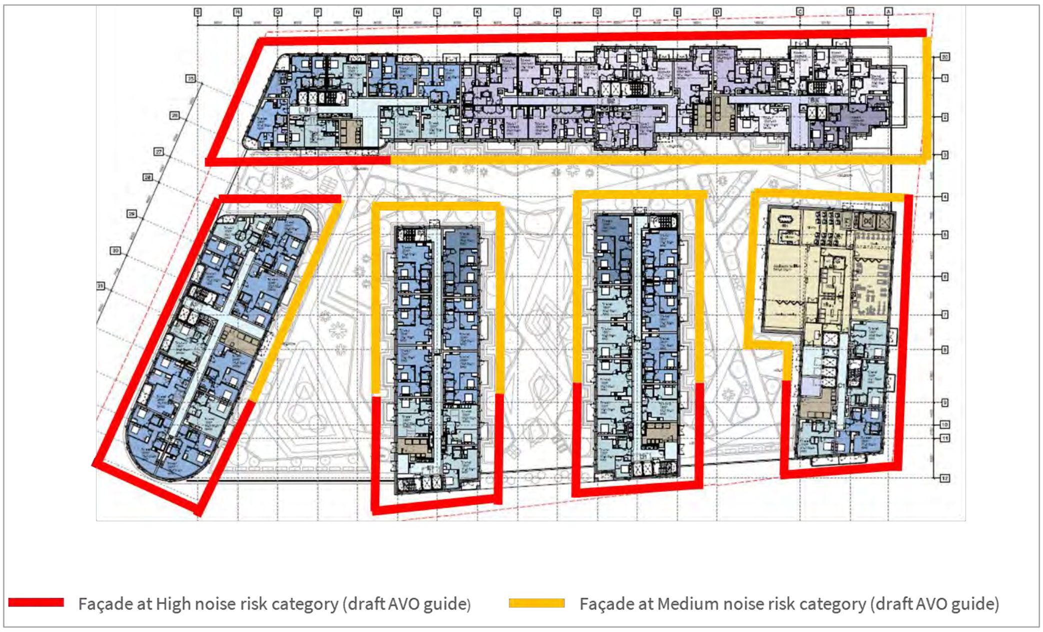

Figure F3.7: Natural ventilation strategy mark-up daytime based on noise modelling results.

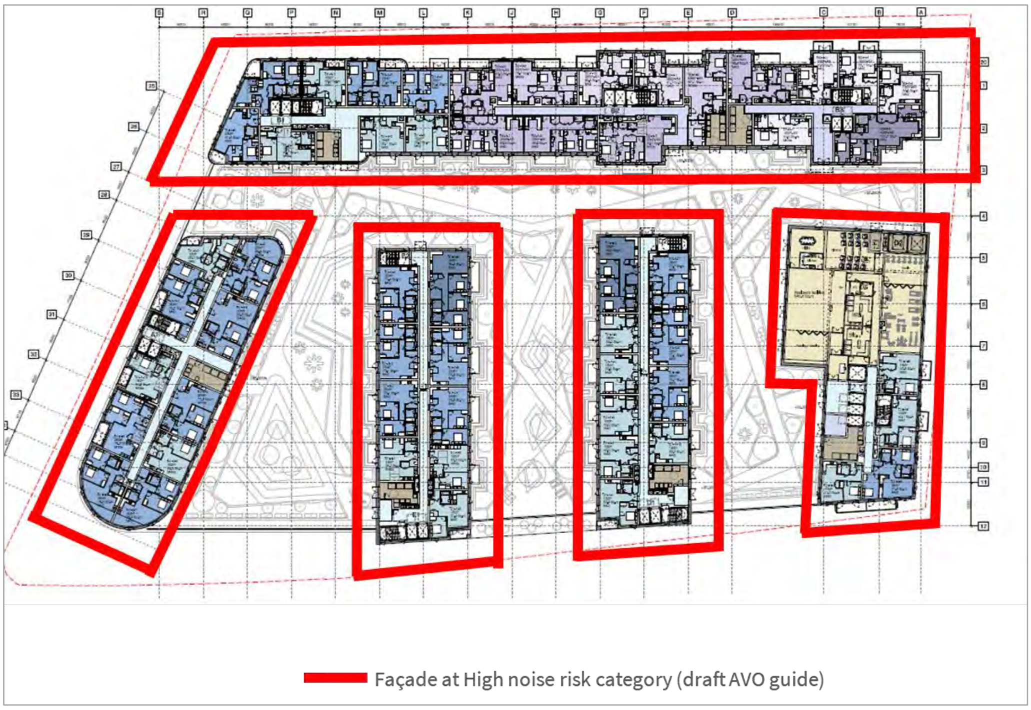

Figure F3.8: Natural ventilation strategy mark-up night-time based on noise modelling results.

APPENDIX F4

Communal Corridor LTHW heat losses

Table below presents the information provided by the M&E consultant regarding the design of the communal heating network. The data has been used to estimate the heat losses generated by the system and entered in thermal dynamic model. Figure F4.2 shows also a schematic diagram of the LTHW pipework used to calculate the length of the pipes running in the ceiling void of the communal corridor.

Table F4.1: Block C – 7th floor Communal Corridor Heat Gain Calculation

Dwelling	Pipe thickness (mm)	Insulation thickness (mm)	Pipe length Flow and return (m)	Losses (W)
Heating Riser	40	40	5	17.1
Ceiling Void	25	40	66.8	175.4

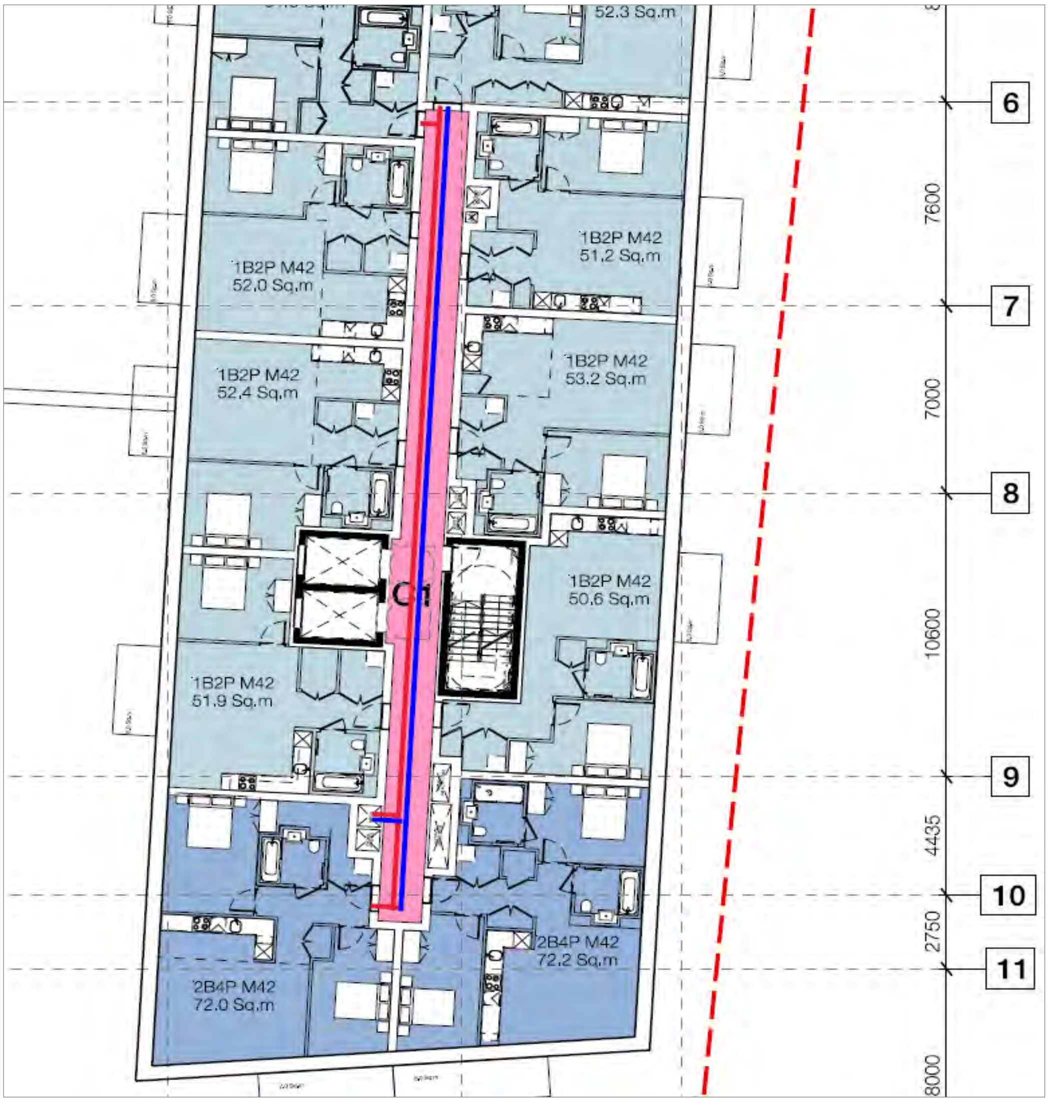

Figure F4.2: Schematic diagram of the location of the heating pipework within the corridor void of Block C 7th floor.

APPENDIX F5
Dwelling Mechanical Ventilation Rates

Minimum Part F ventilation rates have been calculated as per the table below and were used in the overheating assessment (Table F5.1). A mechanical ventilation system capable of delivering at least these rates, should be used and designed to perform as per the Energy Statement stated efficiencies and maintain acceptable internal noise levels.

A maximum of 66 l/s ventilation rates depending on unit size, **to achieve 1.0 ach**, were proposed beyond the minimum Part F required rates to assist in overheating mitigation for the homes whilst considering external noise constraints. (Table F5.2).

Table F5.1: Capacity of mechanical system for Minimum Part F requirements

Dwelling	A1.4.4	B1.4.4	B2.4.2	B3.4.5	D1.4.8	
Floor Area (m^2)	83.8	53	87.1	50.5	70.1	
Storey height (m)	2.5	2.5	2.5	2.5	2.5	
Volume (m^3)	209.5	132.5	217.75	126.25	175.25	
Minimum high rate (l/s)						
Kitchen	13	13	13	13	13	
Utility cupboard	8	8	8	8	8	
Bathroom 1	8	8	8	8	8	
Bathroom 2	8				8	
Toilet			6			
Boost rate (l/s)*	37.00	29.00	35.00	29.00	37.00	
Whole dwelling ventilation rate (m^3/hr)	133.2	104.4	126	104.4	133.2	
Air change Rate (ach)	**0.64**	**0.79**	**0.58**	**0.83**	**0.76**	

*** Maximum whole dwelling extract ventilation rate**

Table F5.1: Capacity of mechanical system for Minimum Part F requirements						
Dwelling	**E1.4.6**	**B1.6.7**	**C1.6.8**	**B2.14.2**		
Floor Area (m^2)	72.8	70.9	71	70.3		
Storey height (m)	2.5	2.5	2.5	2.5		
Volume (m^3)	182	177.25	177.5	175.75		
Minimum high rate (l/s)						
Kitchen	13	13	13	13		
Utility cupboard	8	8	8	8		
Bathroom 1	8	8	8	8		
Bathroom 2	8	8	8	8		
Toilet						
Boost rate (l/s)*	37.00	37.00	37.00	37.00		
Whole dwelling ventilation rate (m^3/hr)	133.2	133.2	133.2	133.2		
Air change Rate (ach)	**0.73**	**0.75**	**0.75**	**0.76**		
*** Maximum whole dwelling extract ventilation rate**						

Table F5.2: Capacity of mechanical system for 1.0 ach						
Dwelling	**A1.4.4**	**B1.4.4**	**B2.4.2**	**B3.4.5**	**D1.4.8**	
Floor Area (m²)	83.8	53	87.1	50.5	70.1	
Storey height (m)	2.5	2.5	2.5	2.5	2.5	
Volume (m³)	209.5	132.5	217.75	126.25	175.25	
Minimum high rate (l/s)						
Kitchen	13	13	13	13	13	
Utility cupboard	8	8	8	8	8	
Bathroom 1	8	8	8	8	8	
Bathroom 2	8				8	
Toilet			6			
Boost rate (l/s)*	58.19	36.81	60.49	35.07	48.68	
Whole dwelling ventilation rate (m³/hr)	209.5	132.5	217.8	126.3	175.3	
Air change Rate (ach)	**1.00**	**1.00**	1.00	**1.00**	**1.00**	
*** Maximum whole dwelling extract ventilation rate**						

Table F5.2: Capacity of mechanical system for 1.0 ach						
Dwelling	**E1.4.6**	**B1.6.7**	**C1.6.8**	**B2.14.2**		
Floor Area (m^2)	72.8	70.9	71	70.3		
Storey height (m)	2.5	2.5	2.5	2.5		
Volume (m^3)	182	177.25	177.5	175.75		
Minimum high rate (l/s)						
Kitchen	13	13	13	13		
Utility cupboard	8	8	8	8		
Bathroom 1	8	8	8	8		
Bathroom 2	8	8	8	8		
Toilet						
Boost rate (l/s)*	50.56	49.24	49.31	48.82		
Whole dwelling ventilation rate (m^3/hr)	182.0	177.25	177.5	175.75		
Air change Rate (ach)	**1.00**	**1.00**	**1.00**	**1.00**		
*** Maximum whole dwelling extract ventilation rate**						

APPENDIX F6

Good Homes Alliance (GHA) Overheating scoresheet

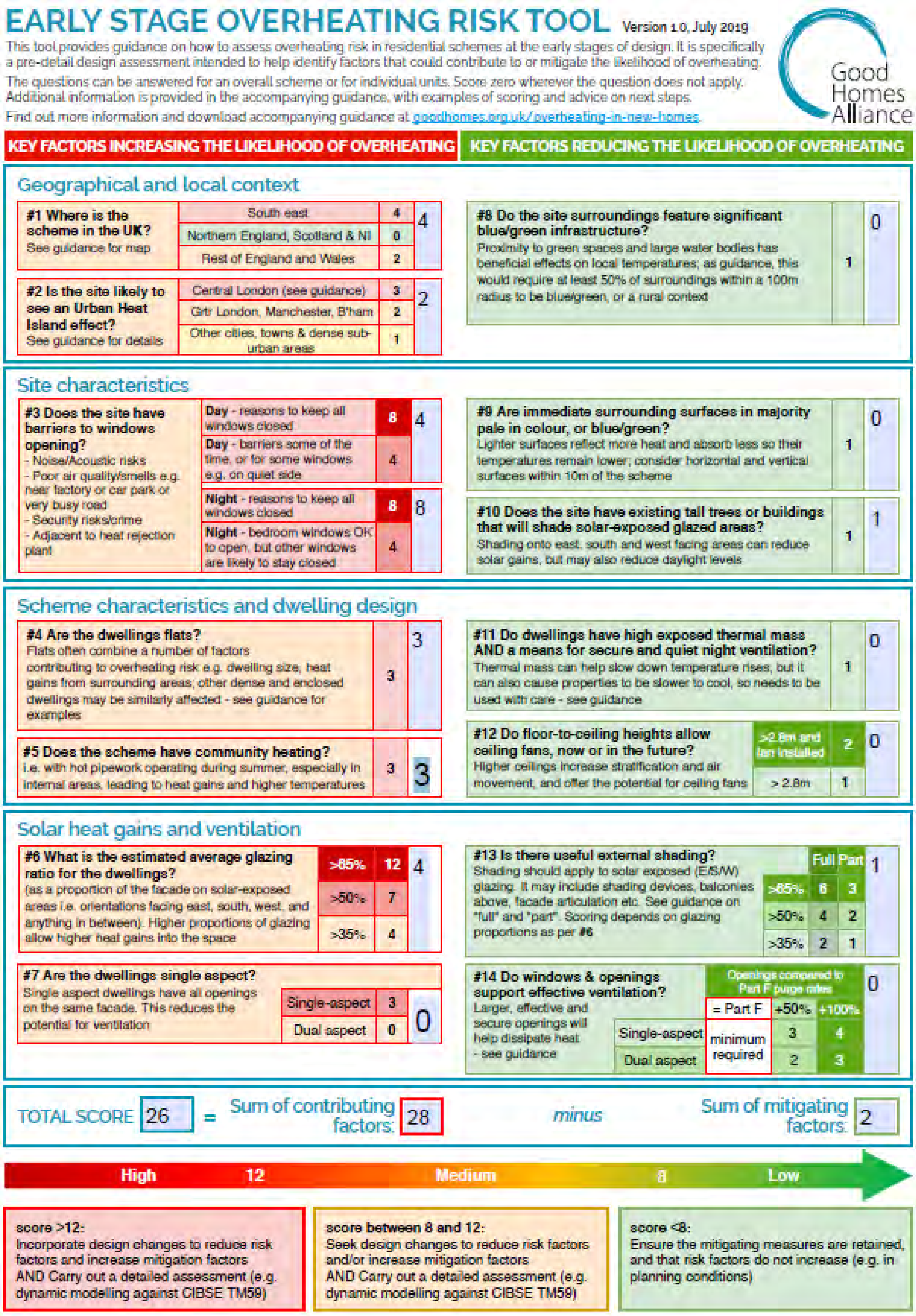

Figure F6.1: GHA Overheating Risk Tool scoresheet.

Appendix G

Indicative ASHP Roof Plant Layout

BUROHAPPOLD
ENGINEERING

MEP

Job Title:
Syon Lane

Job Number:
0043478

Sketch Title/Number:
201117 Roof Plant Layouts

Date:	Initials:
17.11.20	KM

General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

N

Scale 1:250 @ A1

0 1 2 3 4 5m 10m 15m 20m

Title
General arrangement plan
Roof plan

Project
Syon Lane

Scale
1:250 @ A1 1:500 @ A3

Issue Record		By	Chk	Date
P10	Planning Issue	MA	AC	29.07.2020
P09	Planning Issue	MA	AC	28.07.2020
P08	Planning Draft	TG	AC	17.07.2020
P07	Design freeze 3	TG	AC	10.07.2020
P06	Buildings' outlines updated	IT	AC	22.06.2020
P05	Buildings' outlines updated	MA	AC	22.06.2020

Drawing Number 579-PTA-ZZ-RF-DR-A-1001
Revision P10

Status
For Planning

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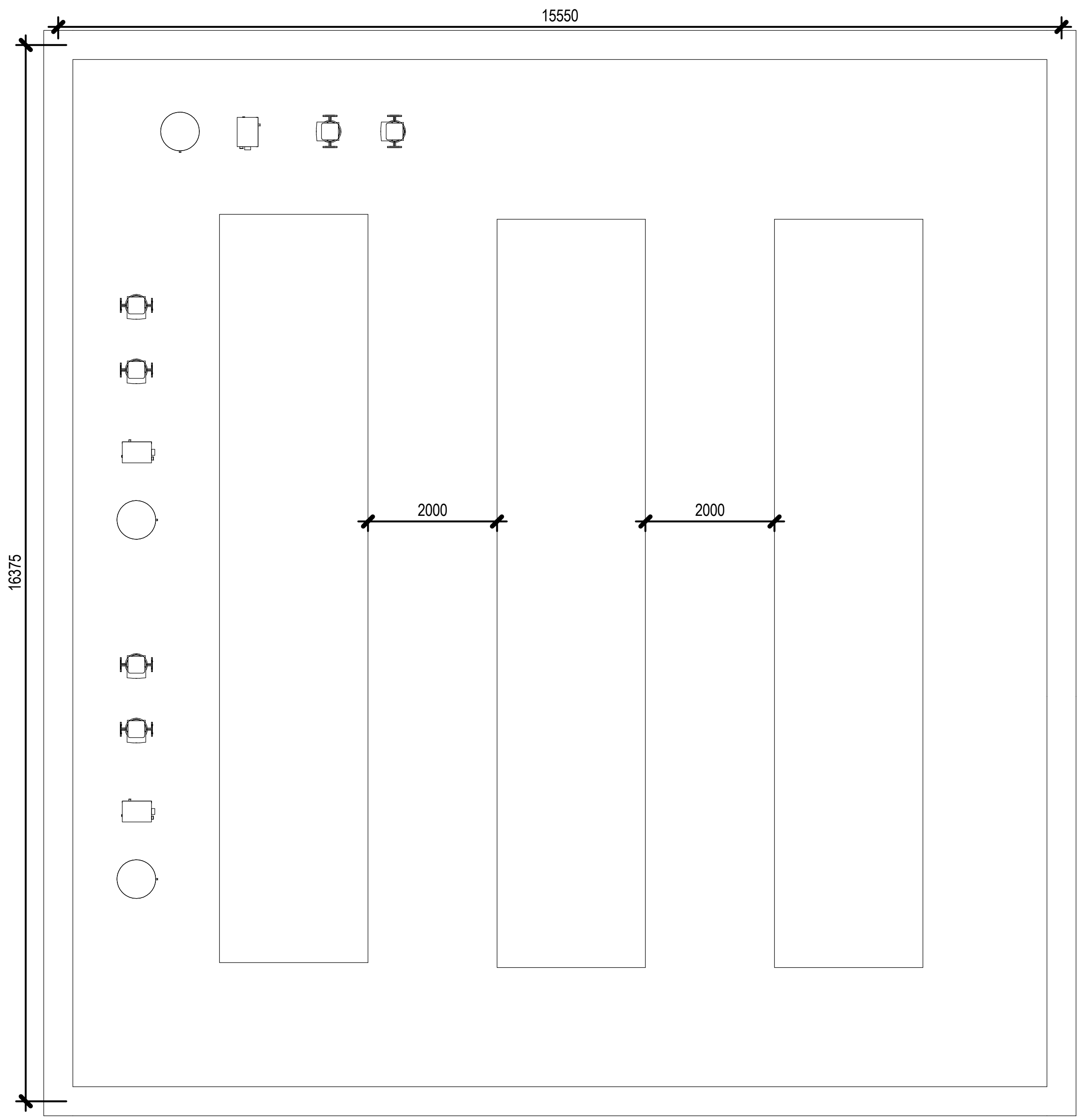
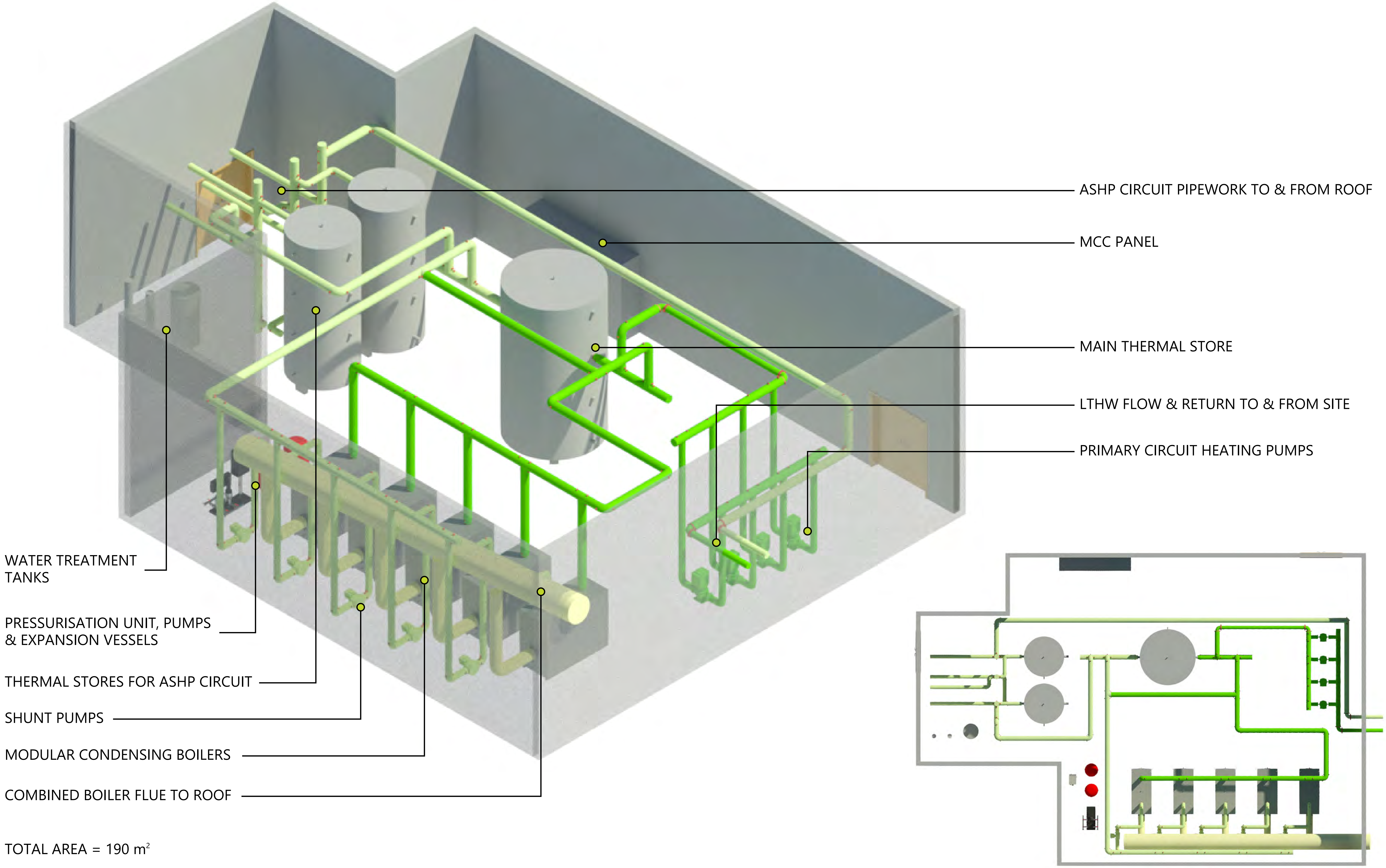


1:100

BUROHAPPOLD ENGINEERING	PROJECT NAME:	Syon Lane	SKETCH TITLE:	Roof Plant Space Layout	SKETCH REV: 00	AUTHOR:	KM
	PROJECT NUMBER:	0043478	SKETCH NUMBER:	201117 Roof Plant Space 4	ISSUE DATE: 17/11/20	CHECKED BY:	WE

Appendix H

Indicative Energy Centre Plan



TOTAL AREA = 190 m^2

BUROHAPPOLD ENGINEERING	Project: Syon Lane	Project Number: 0043478	Status: Stage 2	
	Sketch Title: Basement Energy Centre Layout	Sketch Number: SK-M-01	Date: 19/02/20	Initials: MB / Revision: 00

Appendix I

Whole Life Cycle Assessment Report

HODKINSON

Whole Life Cycle Carbon Emissions Assessment

St Edward Homes Limited

Syon Gardens, Homebase Brentford Site

Final

Zeta Watkins
BSc (Hons), MSc, CEnv, MIEMA

March 2021

HODKINSON

DOCUMENT CONTROL RECORD

REPORT STATUS: FINAL

Version	Date	Reason for issue	Author	Checked by	Approved for Issue by Project Manager
v.1	17.01.2020	Draft	ZW	CS	CS
v.2	06.07.2020	Final Draft	ZW	CS	CS
v.3	24.07.2020	Final	ZW	CS	CS
v. 4	30.07.20	Final (minor update)	ZW	CS	CS
v. 5	31.07.20	Final (minor update)	ZW	CS	CS
v.6	04.09.20	Final (minor updates)	MV	ZW	DS
v.7	08.09.20	Final	MV	ZW	DS
v.8	03.03.21	Final	MV	ZW	DS

ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

HODKINSON

CONTENTS

1. INTRODUCTION

1.1 This Whole Life Cycle Carbon Emissions (WLCCE) review and assessment has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, appointed by St Edward Homes Limited.

1.2 This is an initial review of the Syon Gardens development based on the best available information. The design is still being developed which means that a full WLCCE assessment (in line with the draft GLA guidance) is unable to be done at this stage. Instead a high level WLLCE assessment and a full review of the design has been undertaken. As the design progresses a further review and assessment could take place.

1.3 This review will aim to help St Edward Homes Limited and the design team understand, at an early stage, the lifetime consequences of current design decisions on embodied carbon.

2. POLICY AND REGULATIONS

The London Plan

2.1 It is anticipated that the **Intend to Publish London Plan** will be adopted in 2020, although the policies are already carrying weight with the Greater London Authority (GLA). This includes Policy SI 2:

2.2 **Policy SI 2 Minimising Greenhouse Gas Emissions, states:**

'Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions:

Operational carbon emissions will make up a declining proportion of a development's whole life-cycle carbon emissions as operational carbon targets become more stringent. To fully capture a development's carbon impact, a whole life-cycle approach is needed to capture its unregulated emissions (i.e. those associated with cooking and small appliances), its embodied emissions (i.e. those associated with raw material extraction, manufacture and transport of building materials and construction) and emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal). Whole life-cycle carbon emission assessments are therefore required for development proposals referable to the Mayor. Major non-referable development should calculate unregulated emissions and are encouraged to undertake whole life-cycle carbon assessments. The approach to whole life-cycle carbon emissions assessments, including when they should take place, what they should contain and how information should be reported, will be set out in guidance'.

2.3 The above policy notes that all referable schemes will be required to carry out a WLCCE assessment at the outset of the project, with reporting required at pre-application, planning and post-completion stages once the draft London Plan is adopted.

2.4 This assessment would form a part of the concept design and inform the design and material choices through the course of the project rather than appear as an afterthought later in the design.

2.5 The design detail available as present is not enough to facilitate a full WLCCE assessment, instead a review of the design and a high-level WLCCE assessment from a carbon perspective will be undertaken.

Local Policy: London Borough of Hounslow

2.6 The London Borough of Hounslow's Local Plan was adopted in 2015. The following policies are considered relevant to this Statement:

2.7 **Policy EQ1 - Energy and carbon reduction** requires all development to meet the carbon emission reduction requirements set out in the London Plan.

2.8 **Policy EQ2 - Sustainable design and construction** expects development proposals to:

> Incorporate established principles for sustainable design and construction as set out in the London Plan, including passive solar design, water efficiency standards, sustainable drainage, the reuse and recycling of construction materials, green roofs and urban greening.

> Be assessed against the standards for sustainable design and construction and submit relevant documentation to demonstrate that minimum specified levels are met or meet any national standards that subsequently supersede these.

> All developments over 500 sqm should be assessed against BREEAM standards and meet a rating of 'Excellent' as a minimum.

> All residential developments should meet the standards for sustainable design and construction set out in the London Plan, including any 'optional' Building Regulations requirements it adopts.

> Prepare a sustainability statement, where major developments are proposed.

2.9 **Policy EQ3 - Flood risk and surface water management** requires development proposals to prepare flood risk assessments. Flood resistance, resilience measures, and sustainable drainage systems should be incorporated while avoiding non-permeable hard standings.

2.10 **Policy EQ7 - Sustainable waste management** requires suitable arrangements for waste management, including the location, size and design of waste and recycling facilities, and transport access.

Guidance Documents

2.11 Preliminary guidance has been released by the GLA (Whole Life-Cycle Carbon Assessments guidance - Pre-consultation draft – April 2020); it outlines how to prepare a WLCCE assessment which should accompany all referable planning applications in line with London Plan Policy SI 2.

2.12 In addition, the following guidance is available to conduct assessments:

> **BS EN 15978:2011 -** *Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method.*

> **ISO 14040:2006 -** *Environmental management — Life cycle assessment — Principles and framework.*

> **RICS Professional Statement Whole life carbon assessment:2017 -** *Whole life carbon assessment for the built environment.*

3. DEVELOPMENT OVERVIEW

Site Location

3.1 The development site at Homebase Brentford in the London Borough of Hounslow is located at Syon Lane, Brentford, TW7 5QE as shown in Figure 1.

Figure 1: Site Location – St Edward Client Brief, 2019

3.2 The Homebase Site is a rectangular plot of land located on the corner of Syon Lane and the Great West Road at Gillette Corner. It has an area of approximately 1.4 ha.

3.3 The site is developed with a large Homebase store (4,180sqm) and associated surface car parking and under-croft car parking (295 spaces). The Homebase store comprises of a large industrial style shed with metal cladding. The building is effectively two storeys high with a central pylon to the front.

Development Description

3.4 The development is described as follows:

3.5 *"Full planning application for the demolition of existing building and car park and erection of buildings to provide residential units, a replacement retail foodstore, with additional commercial, business and service space, and a flexible community space, and ancillary plant, access, servicing and car parking, landscaping and associated works"*

3.6 Figure 2 below illustrates the site layout.

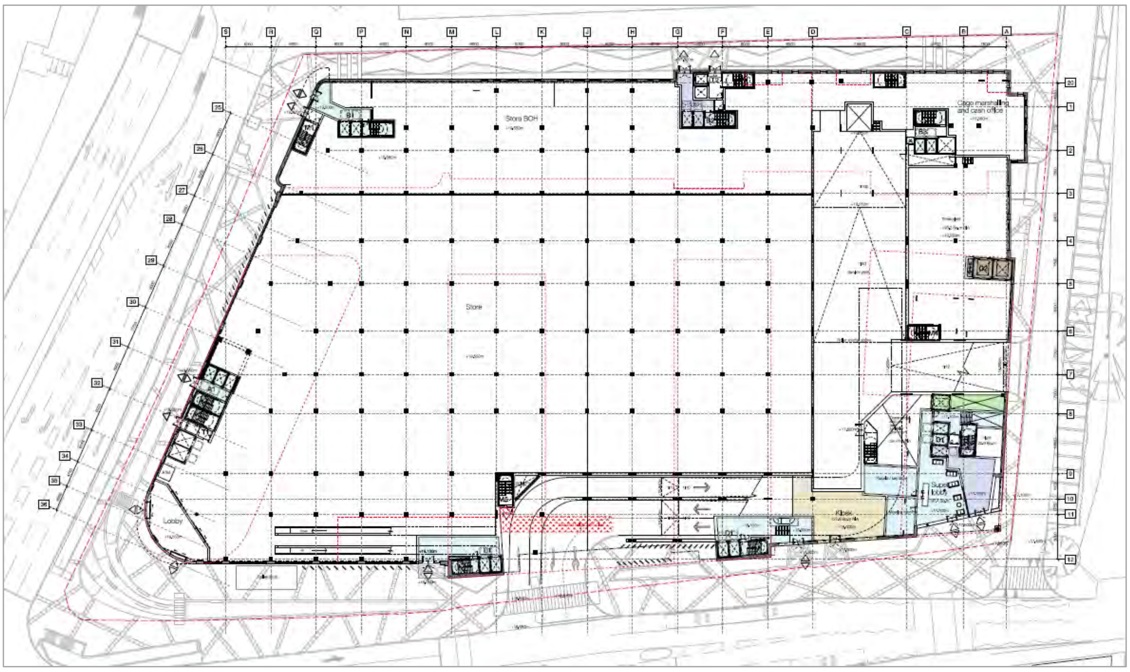


Figure 2: Site layout at ground floor (Patel Taylor, 2020)

4. WHOLE LIFE CYCLE CARBON EMISSIONS ASSESSMENT

4.1 Undertaking WLCCE assessments is way to fully understand and minimise the carbon emissions associated with building designs over the entire life cycle of the building. This will be done at Syon Gardens in order to quantify the carbon dioxide emissions that will be released from the proposed development, considering not only operational and embodied emissions but also demolition, construction, and refurbishment/replacement cycles.

4.2 The design is still in development so a full WLCCE assessment will not be completed at present. In line with the draft GLA guidance a high-level assessment will be undertaken which will demonstrate the expected carbon emissions based on the current design. As the design develops, so will the assessment.

4.3 The Intend to Publish London Plan has introduced a requirement for all new referable developments to calculate and reduce WLCCE, this is both embodied and operational carbon:

> **Operational carbon** is the energy required to heat and power a building;

> **Embodied carbon** is the carbon that is released in the manufacturing, production, and transportation of the building materials used.

4.4 In addition to the two metrics above there are additional life cycle stages that are considered during WLLCE assessments, these include demolition, end of life and refurbishment/replacement cycles.

4.5 The two metrics (operation and embodied) and the additional life cycle stages, as noted above, have been included in this high level WLCCE assessment but additional design information will be required in order to ensure the assessment can give valuable results.

4.6 Embodied and operational carbon are both an important part of the built environment's impact on climate change. Embodied emissions are associated with every stage of a building's lifecycle. The Commission of the European Communities' (2014) TC350 framework defines the life cycle stages as follows:

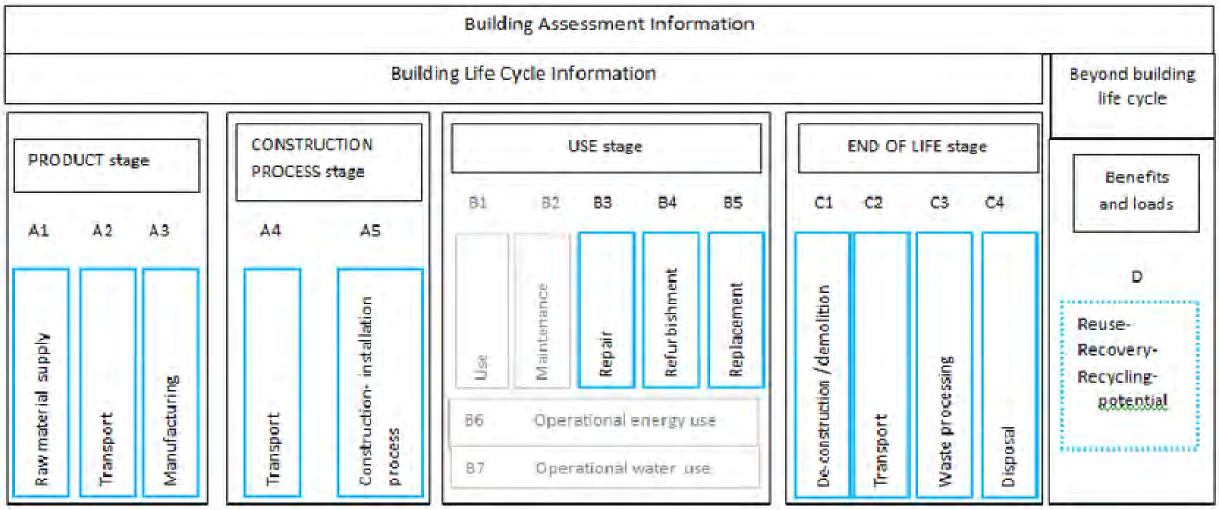


Figure 3: Life Cycle Stages of a Building (Source: BS EN 15978:2012)

4.7 Undertaking a WLCCE assessment provides a full overview of the material and building environmental impacts of a building using science-based metrics (e.g. Global Warming Potential). It also identifies the overall best combined opportunities for reducing lifetime emissions, and also helps to avoid any unintended consequences of focusing on operational emissions alone.

4.8 A low carbon building is one that optimises the use of resources both to build it and to use it over its lifetime. The assessment will help the design team understand, at design stage, the lifetime consequences of their design decisions. This promotes durability, resource efficiency, reuse, and future adaptability, all of which contribute to life-time carbon reductions.

Study Period

4.9 The reference study period (RSP) for domestic projects is 60 years, this is based on the principles outlined in BS EN 15978: 2011, section 7.3. RSPs are fixed to enable comparability between whole life carbon results for different projects. It ensures that the assessment is representative of typical service life of different building elements.

5. METHODOLOGY

5.1 This high-level WLCCE assessment for Syon Lane has been assessed in accordance with the principles outlined in EN 15978 and RICS Professional Statement whole life carbon assessment for the built environment.

5.2 OneClick LCA is the software that has been used to conduct the high level LCA. This is a web based approved LCA and design software for buildings and infrastructure. The overheating model for the project was uploaded to the software so that materials could be allocated to specific areas of the building. OneClick LCA should be run again once a more detailed model is available.

5.3 OneClick LCA consists of a large database of generic and average Life Cycle Indicator (LCI) data, and global Environmental Product Declaration (EPDs)**.** The most suitable option for each material (where available) was chosen from the database in OneClick. The material LCI data has been chosen to be representative of the typical UK supply chain.

5.4 The OneClick LCA default values for distances travelled to site for the construction materials were used for each material item. More specific values will be used when the assessment is re-run once the design of the development has progressed further.

BREEAM 2018 – Materials 01

5.5 The proposed Tesco Store at Syon Gardens will be assessed under the BREEAM New Construction 2018 with a target of achieving the required ‘Excellent’ rating.

5.6 Materials 01 “Environmental impacts from construction products - Building life cycle assessment (LCA)” requires projects to undertake an LCA to understand how the overall environmental impact of their design.

5.7 One Click LCA is officially approved for the BREEAM UK Materials 01 credit by BRE and will be used to assess the design as it progresses in addition to the design being assessed against the new draft London Plan requirements.

6. INITIAL REVIEW

6.1 As noted above, this is a high level WLCCE assessment and an initial review based on the best available information which will need to be updated as the project progresses.

6.2 This section covers the initial observations made on the current design based on key themes which can be considered at this early stage. These include building materials, building heights and form and zero carbon.

Building Heights and Form

6.3 The heights at this development vary across the site, the highest block is 17 storeys high. High-rise buildings gain efficiency in the ratio of envelope to gross floor area because while each floor will typically have a similar amount of façade, the environmental impact of the roof and ground floor is divided by the number of floors – the more floors the better in this respect.

Figure 4: General Arrangement Elevations (Patel Taylor, 2020)

6.4 The avoidance of overly complex building forms and junction designs demonstrated at Syon Gardens offers a more consistent and reliable standard of construction which will assist in air tightness and reducing the impact of heat loss through thermal bridges.

Building Elements

6.5 The client brief notes the use of continuous flight auger (CFA), this is a cast in-situ method of piling, particularly suited to environmentally sensitive sites and soft and/or water-bearing strata where deep casings would otherwise be necessary. These types of foundations can offer substantial reductions in embodied energy when compared with traditional high-volume concrete solutions, such as raft foundations.

6.6 Composite Windows (Rational or similar) are assumed across 30% of the facade. It is known that buildings with very small glazing ratios will produce much more carbon than buildings with larger glazing rations. The optimum glazing ratio is therefore considered to be between 30% and 50% so the development is currently in line with this optimum ratio.

6.7 The landscaping strategy is a mix of both soft and hard landscaping. In order to reduce the embodied carbon of the hard landscaping any demolished concrete should be crushed on-site and potentially used a subbase to reduce the overall embodied carbon of the landscaping.

Zero Carbon

6.8 Major residential developments in London are subject to an additional offset payment to meet a 100% reduction in Regulated CO_2 emissions to achieve the standard of Zero Carbon. This payment is made to the local borough's Carbon Offsetting Fund and is expected to be allocated to carbon reduction savings elsewhere in the borough.

6.9 As set out in the Energy Statement provided by Hodkinson Consultancy the site is meeting the Greater London Authorities (GLA) definition of Net Zero Carbon. Based on this, the operational emissions can be set as zero for the first thirty years when finalising the assessment once the design is more progressed.

7. WHOLE LIFE CYCLE CARBON EMISSIONS ASSESSMENT RESULTS

7.1 A summary of the initial early results has been outlined below. A full detailed OneClick report (compliant with BREEAM and new draft London Plan) will be provided once the developed design has been assessed, typically RIBA 3 or 4.

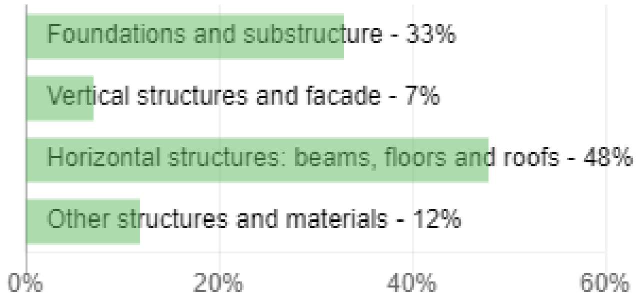


Figure 5: Embodied carbon by structure – A1-A3

7.2 The above figure demonstrates that horizontal structures (beams, floors, and roofs) are the most carbon intensive, based on the indicative LCA that has been conducted. This is not unusual given the height of the blocks. Once more detailed design is available this will be re-assessed.

7.3 These emissions are generated in the material manufacturing stage A1-A3, as demonstrated in Figure 6 below. Foundations and substructure were also shown to be carbon intensive, however as assumptions were made on these elements more details will need to be provided.

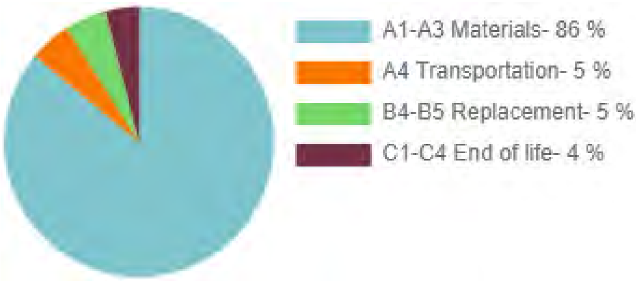


Figure 6: Embodied carbon by life-cycle stage

8. EARLY RECOMMENDATIONS

8.1 A set of early recommendations are set out below. These should be considered as the design progresses to ensure that embodied carbon savings are maximised. These are based on embodied carbon and life cycle only and must be considered alongside other design considerations:

> Using concrete as a finish can reduce the need for other materials. In addition, exposed areas of concrete can optimise the thermal mass performance. Thermal mass, with adequate ventilation, can be used to control daytime peak temperatures of a space and therefore reduce or minimise the need for air-conditioning. The areas where this can be done would need to be carefully considered. The durability of concrete also offers further savings through a reduction in the need for maintenance and repair (compared to a painted finish for example).

> The transportation of materials from the manufacturing facility to the building site adds to the carbon of the development. Buying from local sources reduces the emissions produced during

transportation, once further details of manufacturers and their locations are known the whole life carbon assessment can be updated to reflect this.

- The façade and roof are under constant wear from the environment, this leads to frequent repairs and maintenance. By using durable materials, this reduces the cost and frequency of refurbishment and reduces the use of material replacement and its associated carbon footprint.

- Trialling the use of innovative low carbon materials, such as cement-free concrete, on noncritical areas, such as temporary works before attempting to use them more widely on permanent works.

- Setting carbon performance requirements on the project allows for the reduction of embodied carbon emissions in a meaningful and effective way. This strategy works effectively for all materials where supply is competitive, and some suppliers are willing to supply products with improved environmental performance.

- Slabs are a major contributor to a buildings embodied carbon, they provide structural, acoustic and fire resistance capabilities for the building. Reducing the net thickness of slabs by 10mm reduces the building envelope height correspondingly, thus saving materials from slabs and walls, and energy via reduced conductive loss. The use of hollow slabs or bubble decks could reduce building life-cycle embodied impacts by approximately 6%.

- Recycled aggregates should only be considered within the design when they are locally available, otherwise transportation impacts exceed the intended benefits. The use of recycled aggregates within a project also enables credits to be awarded under BREEAM.

9. CONCLUSION

9.1 This Whole Life Cycle Carbon Emissions (WLCCE) review and assessment has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, appointed by St Edward Homes Limited.

9.2 This is an initial review of the Syon Gardens development based on the best available information. The design is still being developed which means that a full WLCCE assessment (in line with the draft GLA guidance) is unable to be done at this stage. Instead a high level WLLCE assessment and a full review of the design has been undertaken. As the design progresses a further review and assessment could take place.

9.3 This review will aim to help St Edward Homes Limited and the design team understand, at an early stage, the lifetime consequences of current design decisions on embodied carbon.

Appendix J

Correspondence with Sky Campus

From:	Mollie Mills OBrien
To:	Kingston, Patrick (Real Estate Manager)
Cc:	Bentley, Sarah (Programme Head); Chris Beard; Duncan Matthews
Subject:	Sky/Berkeley - Energy Query

Morning Patrick,

I hope you had a good week of leave last week. We discussed having a catch-up this week, would Wednesday pm work?

I also have a query with regards to our proposed energy strategy on the Tesco site. As part of the planning application site as a residential led mixed-use development which will contain a heat network, we are investigating whether there are any available heat suppliers in the area.

Would you please be able to review the below questions and come back to me.

We are required to investigate the possibility of connecting into existing networks but very much appreciate this may not be possible.

- Capacity: We require peak capacity of 5.8MW of heat. Please can you confirm whether you have sufficient excess capacity available?;
- Service Requirement: We require a 100% availability. Please confirm that whether you are able to provide this?
- Low Carbon: We require a low carbon supply. Please can you therefore confirm the carbon intensity (in kg of CO_2 per KWh) of your heat. Ideally this would be provided using SAP10.1 carbon factors so as to align with the planning strategy

If you have any questions, please do let me know.

Many thanks,

Mollie

Mollie Mills O'Brien MRICS

Development Manager

BH02	SE-02	2020

Berkeley Homes (Urban Renaissance) Limited

Chelsea Bridge Wharf | 380 Queenstown Road | London | SW11 8PE

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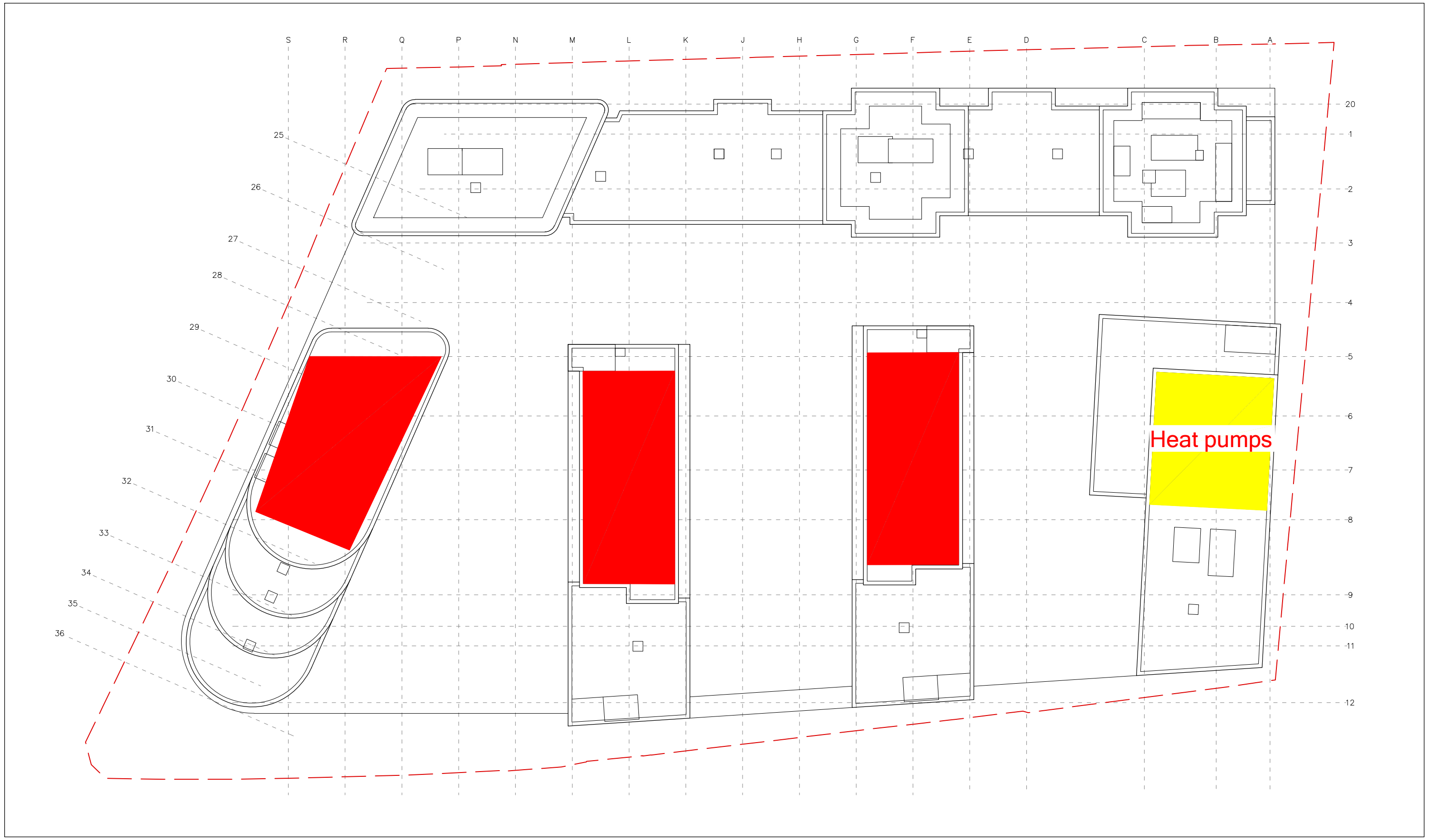
Appendix K

Indicative PV Locations



General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Title
General arrangement plan
Roof plan

Project
Syon Lane

Scale
1:250 @ A1 1:500 @ A3

Issue Record	By	Chk	Date
P07 Design freeze 3	TG	AC	10.07.2020
P06 Buildings' outlines updated	IT	AC	22.06.2020
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Revision: P07

Status
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