September 2020

SYON GARDENS

HOMEBASE BRENTFORD SITE, TW7 5QE

ENERGY STATEMENT

Consultant: Hodkinson Consultancy

St Edward
Designed for life

HODKINSON

Energy Statement

St Edward Homes Limited

Syon Gardens
Homebase Brentford Site

Final

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September 2020

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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***.

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 Intend to Publish London Plan requirements. This can be seen in Tables *i* & *ii*.

In line with the Intend to Publish 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 air source heat pumps and gas boilers. 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 **18%** over the Part L 2013 baseline.

Table *iii*, below, summarises the anticipated CO_2 emissions savings across the entire scheme. The combination of energy efficiency and heat network measures results in an estimated Regulated CO_2 emissions reduction of **36%** over the Part L 2013 baseline. This meets the energy requirements of the Intend to Publish London Plan Policy SI 2 and London Borough of Hounslow local plan policy 2015 - 2030.

The full spectrum of ***Be Green*** renewable energy generating technologies has been considered. No further renewable energy technologies are considered necessary to meet the 35% onsite carbon reduction policy target, which has already been achieved through focusing on energy efficiency and heat network measures.

In line with the GLA guidance, the development will commit to offset the remaining domestic CO_2 emissions 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 **283 Tonnes CO_2 per annum**, resulting in the estimated payment of **£509,400**.

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	389	263
After *Be Clean* Measures	283	263
After *Be Green* Measures	283	263
Stage	Regulated Carbon Dioxide Savings	
	[Tonnes CO_2 per Annum]	Percentage
Savings from *Be Lean* Measures	54	12%
Savings from *Be Clean* Measures	107	24%
Savings from *Be Green* Measures	0	0%
Cumulative On-Site Savings	161	36%

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	236	366
After *Be Green* Measures	236	366
Stage	Regulated Carbon Dioxide Savings	
	[Tonnes CO_2 per Annum]	Percentage
Savings from *Be Lean* Measures	88	24%
Savings from *Be Clean* Measures	40	11%
Savings from *Be Green* Measures	0	0%
Cumulative On-Site Savings	128	35%

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	665	142	18%
After *Be Clean* Measures	519	146	18%
After *Be Green* Measures	519	0	0%
Cumulative On-Site Savings	-	288	36%

Table *iv*: Carbon Offset	
	Residential
Residual CO_2 [TCO_2/year]	283
Carbon Price (£/t)	£60
Carbon Offset Payment	**£509,400**

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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 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.

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

1.4 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 Figure 1, below.

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

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 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.

2.8 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

2.9 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.

2.10 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 (2016)

3.5 **Policy 5.2 – Minimising Carbon Dioxide Emissions** requires that all residential and non-residential major development achieve a 35% improvement beyond Part L 2013.

Residential buildings are also required to achieve a standard of Zero Carbon. The remaining regulated carbon dioxide emissions, to 100%, are to be off set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere. This is defined under the London Plan Housing SPG (2016).

3.6 **Policy 5.3 – Sustainable Design and Construction** states that Major development should meet the minimum standards outlined in the London Plan Supplementary Planning Guidance and this should be clearly demonstrated. The standards include the following sustainable design principles (summarised):

> Minimising CO_2 emissions;

> Avoiding internal overheating and contributing to the urban heat island effect;

> Minimising pollution (including noise, air and urban run-off).

3.7 **Policy 5.5 – Decentralised Energy Networks** states the Mayor will prioritise the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

3.8 **Policy 5.6 - Decentralised Energy** requires that all developments should evaluate the feasibility of Combined Heat and Power (CHP) systems and examine the opportunities to extend the system beyond the site boundary to adjacent sites.

Intend to Publish London Plan (2019)

3.9 The Panel of Inspectors report into the draft New London Plan was published in October 2019. The Mayor considered these recommendations and prepared an Intend to Publish version of the New London Plan which was sent to the Secretary of State with a schedule of the panel's recommendation and the Mayor's response to them. The New London Plan is expected to be adopted in late 2020.

3.10 The following policies in the Intend to Publish London Plan are considered relevant to this energy strategy:

3.11 **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.'

3.12 **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.'

3.13 **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

3.14 The Hounslow Local London Plan

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

3.16 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

3.17 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 aim for the Intend to Publish 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.

5.2 This section outlines the currently proposed strategies for achieving these targets. These measures, or alternatives, will be provided to achieve the policy requirements.

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/m^2.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%.

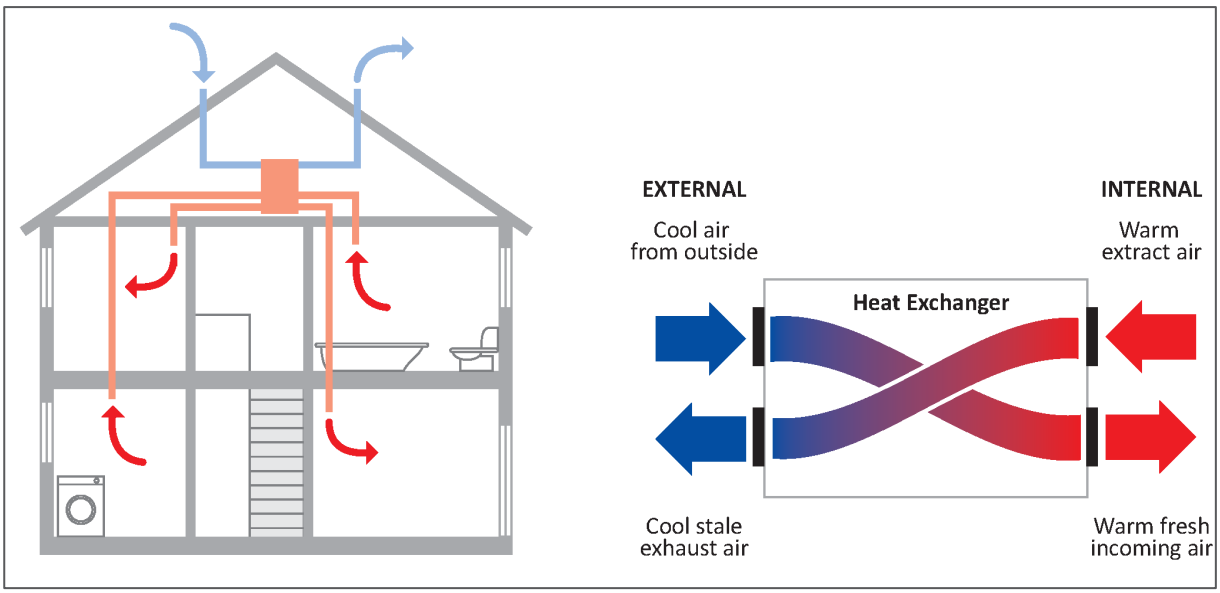

Figure 3: Mechanical Ventilation with Heat Recovery

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 7.

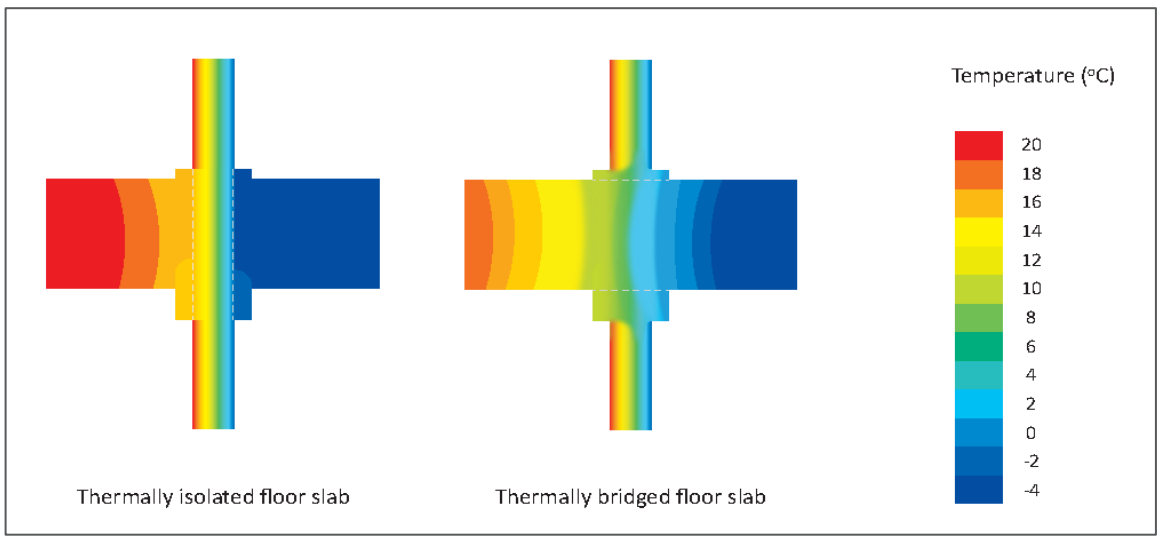

Figure 4: Thermal Bridges

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 Intend to Publish 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^{2}K;

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

> Glazing U-value of 1.3 W/m^{2}K, 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^{2}K;

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

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

> Glazing U-value of 1.3 W/m^{2}K, 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.

Cooling

5.32 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.

5.33 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

5.34 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

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

5.36 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 complies with emerging London Plan policy. 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	389	12%
Non-Residential	364	276	24%
Total	807	665	18%

Whole Life Cycle Assessment

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

6. BE CLEAN: HEATING INFRASTRUCTURE

6.1 In line with the Intend to Publish 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 8. 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 K.

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.

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

6.6 Consideration has been given to the available secondary heat sources. Only air is considered feasible. Therefore, it is proposed that the lead heat source for the development is air source heat pumps.

6.7 Heat pumps are limited in the temperature of heat they can provide at a reasonable coefficient of performance (COP). As such, it is not feasible for a communal system of this size and type to generate 100% of heat from heat pumps.

6.8 The current design concept is for the heat pumps to raise the temperature on the network from 30^0C to 50^0C, with gas boilers providing further temperature uplift, as they are more suited to higher temperature generation. This is a reduction over traditional designs and has two major benefits:

> Enables a greater proportion of heat to be generated from the heat pumps;

> Minimises network heat losses.

6.9 Further reduction in network temperatures could compromise supply temperatures within homes, especially hot water provision.

6.10 It is expected that the heat pumps would generate 66% of the heat. There will be times of very low external temperatures where the heat pumps do not operate.

6.11 The heat losses on the network will be minimised as far as possible. It is expected that a distribution loss factor of 1.3 can be achieved by utilization of the low flow & return temperatures, pipe insulation, lean pipe sizing, etc.

6.12 The current indicative Air-Source Heat Pump unit initially selected by Buro Happold is manufactured by Daikin and achieves a Seasonal COP of up to 4.06. As this is very early stage of the project, we have retained use of a lower SCOP to ensure that a reasonable range of manufacturers is available throughout the detailed design process. This is considered to be a prudent and appropriate position for this early stage of the project and ensures that the performance allowed for currently can be achieved in construction.

6.13 If this unit would be adapted in the later stage, it would positively impact the energy demand figures which would result in a lower carbon offset payment. Therefore, we have used a SCOP of 2.81 for the purpose of the Energy Statement.

6.14 It has been estimated that a heat pump capacity of 3 no. 507 kW units is necessary when using this example product. Other designs that achieve the performance specification may be taken forward during detailed design to achieve the above. Datasheets of the three heat pumps are shown in Appendix H.

6.15 For resilience, the gas boilers are to be designed to the full peak capacity of the site.

6.16 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.

6.17 An indicative roof plan of Block C is provided within Appendix G to illustrate the extent of the heat pump external units.

6.18 In addition to the heat pump internal units and 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 I.

6.19 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.

6.20 Heat losses are assumed within the SAP calculations to align with the CIBSE Heat Networks Code of Practice, which it is intended to adhere to in the design and construction of the heat network.

Heat Network Operation

6.21 Whilst heat pump led heat networks are generally not able to achieve the same level of operational economics as CHP-led schemes it is expected that heat bills to occupants will be below a conventional comparison to individual gas boilers in each home. Evidence from other schemes demonstrates this.

6.22 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.

6.23 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

6.24 Table 5 & Table 6 below, shows the information that was provided to the air quality consultants. Further information of the air quality assessment can be found within the Environmental Statement submitted as part of the planning application.

Table 5: Air Quality

Performance standards	ASHP	Boiler
Proportion of annual heat demand provided	66%	34%
Heat efficiency	~ 281%	95%
NO_X emissions	0 mg/ Nm^3	40 mg/kWh

Table 6: Total fuel consumption [kWh p.a.]

Energy Source	Residential [kWh/yr]	Non-Residential [kWh/yr]	Notes
Grid Electricity	640,000	744,155	Accounting for heat pump led energy centre
Communal Gas Boilers	655,000	112,757	-
Connection to existing DH network	N/A	N/A	No connection available
Other non-regulated uses (e.g. cooking)	268,000	1,572,766	-
TOTALs	1,563,000	2,430,000	3,993,000

CO_2 Emissions at Be Clean Stage

6.25 The carbon benefit of heat pump inclusion is accounted for in this Section. Results can be seen in Table 7 below.

Heat Pumps

6.26 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.

6.27 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.

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

6.29 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.

6.30 For Tesco the heating & cooling will be provided by heat pump with seasonal coefficient of performance (SCOP) > 4.2

Table 7: Be Clean using SAP 10 Carbon Factors (Regulated CO_2)

	Baseline (Part L 2013) [TCO_2/year]	Be Clean [TCO_2/year]	Reduction Achieved [%]
Residential	443	283	36%
Non-Residential	364	236	35%
Total	**807**	519	36%

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.

Photovoltaics (PV)

7.7 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.

7.8 It is not proposed to install any PV at this stage, as in line with the London Plan Energy Hierarchy, CO2 reductions have been maximised through the Be Lean and Be Clean stages of the energy strategy and the minimum on-site CO_2 reduction of 35% has already been achieved. Additionally, these roof spaces

also provide an opportunity to provide amenity space for residents and to provide biodiverse roofs that contribute to the urban greening factor for the development, achieving a net gain in biodiversity.

7.9 At ***Be Green*** stage of the hierarchy, the results remained the same as per ***Be Clean*** stage.

7.10 Full SAP worksheets and BRUKL worksheets supporting these calculations are presented in Appendices B and E, respectively.

8. BE SEEN

8.1 The Intend to Publish 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 The Intend to Publish London Plan policy requires that all major residential developments are subject to an additional offset payment to meet a 100% reduction in Regulated CO_2 emissions to achieve a 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 **Table 8** shows summary of regulated carbon emissions. These values have been used for calculation the Carbon offset. Detail can be found in Appendix C.

Table 8: Summary CO_2 Emissions (SAP10 Carbon Factors)

	Residential [TCO_2/year]	Non-Residential [TCO_2/year]	Total [TCO_2/year]
Baseline	443	364	807
Be Lean	389	276	665
Be Clean	283	236	519
Be Green	283	236	519
Reduction Achieved	36%	35%	36%

9.3 The GLA carbon offsetting policy sets the offset payment price for the development at £60 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 283 tonnes CO_2 per annum. Therefore, the estimated payment due to the London Borough of Hounslow is £509,400 as shown in Table 9 below.

Table 9: Carbon Offset

	Residential
Residual CO_2 [TCO_2/year]	283
Carbon Price (£/t)	£60
Carbon Offset Payment	£509,400

10.SUMMARY

10.1 The purpose of this Energy Statement has been to outline the energy strategy for the development at Homebase Brentford, 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***, ***Be Green*** *and* ***Be Seen***. The overriding objective in the formulation of the strategy is to maximise the reductions in Regulated CO_2 emissions through the application of this hierarchy with a cost-effective, viable and technically appropriate approach.

10.2 A range of advanced ***Be Lean*** energy efficiency measures have been proposed. They enable the development to exceed the Part L 2013 Target Emissions Rate (TER) and the Target Fabric Energy Efficiency (TFEE) standard for the residential aspects of the development, through energy efficiency measures alone, which represents a good level of sustainable design. The regulated carbon emission reduction at the ***Be Lean*** stage is estimated to be **12%** for the residential areas, and **24%** for non-residential areas, which exceeds draft London Plan requirements.

10.3 In line with the Intend to Publish 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 air source heat pumps led technology supplying the heating and hot water demand to the development. Provision will be made for future connection to external heat networks. This deliver a CO_2 reduction of **18%**.

10.4 The full spectrum of ***Be Green*** renewable energy generating technologies has been considered. No further renewable energy technologies are considered suitable for the development at this stage.

10.5 Table *iii* below summarises the anticipated CO_2 emissions savings across the entire scheme. As shown, the combination of ***Be Lean***, ***Be Clean*** and ***Be Green*** measures result in an estimated Regulated CO_2 emissions reduction of **36%** over the Part L 2013 baseline assuming SAP 10 carbon emission factors. This meets the energy requirements of the Intend to Publish London Plan Policy SI2 and London Borough of Hounslow local plan policy.

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	665	142	18%
After Be Clean Measures	519	146	18%
After Be Green Measures	519	0	0%
Cumulative On-Site Savings	-	288	36%

10.6 In line with the GLA guidance, the development will commit to offset the remaining domestic CO_2 emissions through a payment to the London Borough of Hounslow. The remaining CO_2 emissions to be offset should be based upon **283 Tonnes CO_2 per annum**, resulting in the estimated payment of **£509,400**. This has been calculated assuming carbon price £60 per tonne, over 30 years.

APPENDICES

Appendix A
Full SAP 2012 Outputs – *Be Lean*

Appendix B
Full SAP 2012 Outputs– *Be Green*

Appendix C
GLA Carbon Emission Reporting Spreadsheet

Appendix D
BRUKL Outputs – *Be Lean*

Appendix E
BRUKL Outputs – *Be Green*

Appendix F
Dynamic Overheating Assessment report

Appendix G
Indicative ASHP Roof Plant Layout

Appendix H
Indicative ASHP Data Sheets

Appendix I
Indicative Energy Centre Plan

Appendix J
Whole Life Cycle Assessment Report

Appendix K
Correspondence with Sky Campus

Appendix A

Full SAP 2012 – Be Lean

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

HODKINSON

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

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	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 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)			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

	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 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	0.4000	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, nil,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)

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	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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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 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							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 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)			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)

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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	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)

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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	
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)

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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	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)

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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

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	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 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)

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

HODKINSON

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		

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

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

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

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	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							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)			16.3500	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

	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)

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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	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)

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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	
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)

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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	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

	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)

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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)

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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	
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, nil,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)

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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	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 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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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

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: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

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

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	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 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)			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

	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 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	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)

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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)

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	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)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions 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 (negative value allowed since DFEE <= TFEE)			748.4185	(373)
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

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	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 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							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 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)			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)

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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													
	10.9938	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)

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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	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)

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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	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)

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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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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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

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	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 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)			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

	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)

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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	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)

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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	
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)

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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	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)

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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)

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	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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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 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							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 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)			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)

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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 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	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, nil,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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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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

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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

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	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 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)			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

	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)

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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	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)

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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	
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)

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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	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)

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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)

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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 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							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 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)			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)

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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	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)

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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	
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)

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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	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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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	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 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)			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

	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(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 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	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)

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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 (negative value allowed since DFEE <= TFEE)			876.4569	(373)
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

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	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 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) =	0.1600	(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 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)			16.6300	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 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)

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, nil,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

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 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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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: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

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	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

	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 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)

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)

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	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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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							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 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)			16.2500	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

	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)

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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	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)

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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	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)

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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	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)

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												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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

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

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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: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

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	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 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)			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

	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)

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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	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 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	
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)

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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	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)

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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)

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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 (negative value allowed since DFEE <= TFEE)			738.7117	(373)
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

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	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 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) =	0.1563	(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 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)			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)

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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	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 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	
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)

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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	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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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)	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)

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, nil,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)
```

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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							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 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)			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)

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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	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)

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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	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)

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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	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)

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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

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 (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)

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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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

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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

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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

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)	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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 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)

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	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)

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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

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	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							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 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)			16.2000	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

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)

---

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)

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)

---

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)

---

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

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													
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

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

Property Reference	001 BlcA2-1B2P- Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	1B2P no cooling	**Prop Type Ref**	Exposed Floor
Property	001 Block A2-1B2P- Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	83 B	**DER**	16.73	**TER**	19.63
Environmental	89 B	**% DER<TER**	14.77		
CO_2 Emissions (t/year)	0.73	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.73 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

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	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 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)			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

	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 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	0.4000	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, nil,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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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	1196.8396	(98)
Space heat from Boilers = (98) x 0.34 x 1.00 x 1.30	529.0031	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1026.8884	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	700.3239	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1359.4523	(310b)
Electricity used for heat distribution	36.1567	(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	3984.5169	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1294.0284	0.2160	279.5101	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	849.2315	0.5190	440.7512	(368)
Electrical energy for heat distribution	36.1567	0.5190	18.7653	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			739.0266	(373)
Space and water heating			739.0266	(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			930.4594	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7300	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		16.7300	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		36.9080	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		36.9080	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	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 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							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 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)			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)

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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	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)

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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	
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)

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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	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)

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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

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	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 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)

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

HODKINSON

Property Reference	002 BlcD2-3B5P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	3B5P no cooling	**Prop Type Ref**	Exposed Floor
Property	002 Block D2-3B5P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	14.61	**TER**	15.79
Environmental	89 B	**% DER<TER**	7.45		
CO_2 Emissions (t/year)	0.99	**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		

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.79 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.61 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

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	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							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)			16.3500	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

	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)

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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	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)

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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	
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)

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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	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

	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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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	1899.6146	(98)
Space heat from Boilers = (98) x 0.34 x 1.00 x 1.30	839.6296	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1629.8693	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	819.4664	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1590.7289	(310b)
Electricity used for heat distribution	48.7969	(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	5396.4801	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1746.4169	0.2160	377.2260	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	1146.1204	0.5190	594.8365	(368)
Electrical energy for heat distribution	48.7969	0.5190	25.3256	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			997.3881	(373)
Space and water heating			997.3881	(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			1265.6000	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			14.6100	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		14.6100	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		32.6199	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		32.6199	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)

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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	
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, nil,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)

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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	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 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)

Property Reference	003 BlcE1-1B1P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	1B1P no cooling	**Prop Type Ref**	Middle floor
Property	003 Block E1-1B1P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	80 C	**DER**	22.37	**TER**	24.16
Environmental	87 B	**% DER<TER**	7.41		
CO_2 Emissions (t/year)	0.73	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 24.16 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 22.37 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%)

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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

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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

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	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 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)			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

	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 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	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)

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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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	650.3739	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1262.4905	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	627.5540	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1218.1930	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1345.1872	0.2160	290.5604	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	882.8055	0.5190	458.1761	(368)
Electrical energy for heat distribution	37.5861	0.5190	19.5072	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			768.2437	(373)
Space and water heating			768.2437	(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			901.6606	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			22.3700	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		22.3700	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		44.1467	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		44.1467	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	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 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							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 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)			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)

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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													
	10.9938	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 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	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)

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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	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)

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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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

Property Reference	004 BlcC1-1B2P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	1B2P no cooling	**Prop Type Ref**	Middle floor
Property	004 Block C1-1B2P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	14.22	**TER**	15.87
Environmental	91 B	**% DER<TER**	10.39		
CO_2 Emissions (t/year)	0.61	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.87 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.22 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

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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

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	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 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)			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

	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)

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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	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)

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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	
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)

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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	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)

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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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	230.3334	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	447.1178	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	675.0477	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1310.3868	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	953.0328	0.2160	205.8551	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	625.4465	0.5190	324.6067	(368)
Electrical energy for heat distribution	26.6289	0.5190	13.8204	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			544.2822	(373)
Space and water heating			544.2822	(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			716.4545	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			14.2200	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		14.2200	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		34.8247	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		34.8247	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	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 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							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 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)			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)

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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 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	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, nil,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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

Property Reference	005 BlcD2-2B3P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	2B3P no cooling	**Prop Type Ref**	Middle floor
Property	005 Block D2-2B3P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	14.36	**TER**	15.32
Environmental	90 B	**% DER<TER**	6.26		
CO_2 Emissions (t/year)	0.73	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.32 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.36 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

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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

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	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 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)			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

	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)

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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	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)

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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	
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)

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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	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)

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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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	419.4230	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	814.1740	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	731.4062	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1419.7885	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1211.3991	0.2160	261.6622	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	795.0044	0.5190	412.6073	(368)
Electrical energy for heat distribution	33.8479	0.5190	17.5671	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			691.8366	(373)
Space and water heating			691.8366	(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			892.9418	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			14.3600	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		14.3600	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		34.0633	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		34.0633	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	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 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							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 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)			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)

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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	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)

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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	
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)

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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	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

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 kWh/year	Emission factor kg CO2/kWh	Emissions 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 BlcE2-2B4P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	006 Block E2-2B4P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	15.14	**TER**	15.44
Environmental	89 B	**% DER<TER**	1.95		
CO_2 Emissions (t/year)	0.90	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.44 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.14 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

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	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 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)			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

	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(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 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	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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	712.6159	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1383.3132	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	783.9380	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1521.7620	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1575.3199	0.2160	340.2691	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	1033.8346	0.5190	536.5602	(368)
Electrical energy for heat distribution	44.0163	0.5190	22.8445	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			899.6737	(373)
Space and water heating			899.6737	(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			1135.4849	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1400	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.1400	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		33.9698	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		33.9698	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	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 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) =	0.1600	(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 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)			16.6300	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 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)

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, nil,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

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 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)

Property Reference	007 BlcB1-2B4P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	007 Block B1-2B4P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	84 B	**DER**	15.05	**TER**	16.15
Environmental	89 B	**% DER<TER**	6.83		
CO_2 Emissions (t/year)	0.94	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.15 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.05 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

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	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

	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 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)

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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	806.7002	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1565.9475	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	803.5197	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1559.7736	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1694.9684	0.2160	366.1132	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	1112.3563	0.5190	577.3129	(368)
Electrical energy for heat distribution	47.3594	0.5190	24.5795	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			968.0056	(373)
Space and water heating			968.0056	(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			1217.2702	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			15.0500	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.0500	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		33.4673	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		33.4673	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	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							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 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)			16.2500	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

	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)

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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	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)

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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	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)

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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	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)

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												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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

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

Property Reference	008 BlcA2-2B4P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Middle floor
Property	008 Block A2-2B4P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	85 B	**DER**	13.01	**TER**	13.65
Environmental	90 B	**% DER<TER**	4.66		
CO_2 Emissions (t/year)	0.81	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.01 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

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	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 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)			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

	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)

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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	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 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	
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)

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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	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)

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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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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 Boilers = (98) x 0.34 x 1.00 x 1.30	471.1090	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	914.5057	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	790.2444	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1534.0038	(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 kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1327.7404	0.2160	286.7919	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	871.3557	0.5190	452.2336	(368)
Electrical energy for heat distribution	37.0986	0.5190	19.2542	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			758.2797	(373)
Space and water heating			758.2797	(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			998.8839	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			13.0100	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		13.0100	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		31.7150	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		31.7150	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	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 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) =	0.1563	(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 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)			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)

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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	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 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	
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)

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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	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 kWh/year	Emission factor kg CO2/kWh	Emissions 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)

Property Reference	009 BlcB3-1B2P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	1B2P no cooling	**Prop Type Ref**	Top floor
Property	009 Block B3-1B2P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	80 C	**DER**	21.38	**TER**	23.31
Environmental	87 B	**% DER<TER**	8.29		
CO_2 Emissions (t/year)	0.87	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 23.31 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 21.38 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

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)	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)

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)
```

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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         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)
```

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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                               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, nil,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)
```

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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	1983.4204	(98)
Space heat from Boilers = (98) x 0.34 x 1.00 x 1.30	876.6718	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	1701.7747	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	680.8925	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1321.7325	(310b)
Electricity used for heat distribution	45.8107	(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	4902.4947	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	1639.5414	0.2160	354.1409	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	1075.9812	0.5190	558.4343	(368)
Electrical energy for heat distribution	45.8107	0.5190	23.7758	(372)
Total CO2 associated with community systems			936.3510	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			936.3510	(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			1103.1696	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			21.3800	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		21.3800	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		41.8798	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		41.8798	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	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							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 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)			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)

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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	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)

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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	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)

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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	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)

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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

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 (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)

Property Reference	010 BlcB1-2B4P-Be Clean	**Issued on Date**	22/07/2020
Assessment Reference	2B4P no cooling	**Prop Type Ref**	Top floor
Property	010 Block B1-2B4P-Be Clean, Syon Lane, Brentford, London, TW7 5QE		

SAP Rating	82 B	**DER**	17.88	**TER**	19.29
Environmental	87 B	**% DER<TER**	7.32		
CO_2 Emissions (t/year)	1.08	**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		

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.12r02

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
Fuels for main heating:Mains gas (c), Electricity (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.29 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.88 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

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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

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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

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)	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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 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)

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	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)

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	0.3400	(303a)
Fraction of heat from community Heat pump	0.6600	(303b)
Fraction of total space heat from community Boilers	0.3400	(304a)
Fraction of total space heat from community Heat pump	0.6600	(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	2512.4685	(98)
Space heat from Boilers = (98) x 0.34 x 1.00 x 1.30	1110.5111	(307a)
Space heat from Heat pump = (98) x 0.66 x 1.00 x 1.30	2155.6980	(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 Boilers = (64) x 0.34 x 1.00 x 1.30	792.9540	(310a)
Water heat from Heat pump = (64) x 0.66 x 1.00 x 1.30	1539.2636	(310b)
Electricity used for heat distribution	55.9843	(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	6067.1524	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	2003.6474	0.2160	432.7878	(367)
Efficiency of heat source Heat pump			281.0000	(367b)
Space heating from Heat pump	1314.9329	0.5190	682.4502	(368)
Electrical energy for heat distribution	55.9843	0.5190	29.0558	(372)
Total CO2 associated with community systems			1144.2939	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1144.2939	(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			1387.5626	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8800	(384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.8800	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		36.5292	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		36.5292	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	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							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 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)			16.2000	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

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)

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

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													
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 C

GLA Carbon Emission Reporting Spreadsheet

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET							REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)						REGULATED CO2 EMISSIONS PER UNIT						
				Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A													
1B2P with Cooling	*55.6*	*18*	*1000.8*	**19.6**	**19.6**	*2355.2136*	*Natural Gas*	*1844.6928*	*Natural Gas*	*279.8198*	*75*		**509**	**398**	**145**	**39**		**1,091**	**495**	**387**	**65**	**17**		**965**	**17.3**
3B5P with Cooling	*86.6*	*56*	*4849.6*	**15.8**	**15.8**	*3092.0862*	*Natural Gas*	*2163.8616*	*Natural Gas*	*371.5144*	*75*		**668**	**467**	**193**	**39**		**1,367**	**649**	**454**	**87**	**17**		**1,208**	**13.9**
1B1P with Cooling	*40.3*	*19*	*765.7*	**24.2**	**24.2**	*2081.618*	*Natural Gas*	*1757.6078*	*Natural Gas*	*194.1534*	*84*		**450**	**380**	**101**	**44**		**974**	**437**	**369**	**45**	**20**		**871**	**21.6**
1B2P with Cooling	*50.4*	*138*	*6955.2*	**15.9**	**15.9**	*1111.5033*	*Natural Gas*	*1807.9348*	*Natural Gas*	*251.0355*	*75*		**240**	**391**	**130**	**39**		**800**	**233**	**380**	**58**	**17**		**689**	**13.7**
2B3P with Cooling	*62.2*	*67*	*4167.4*	**15.3**	**15.3**	*1588.3875*	*Natural Gas*	*1951.1576*	*Natural Gas*	*287.8882*	*75*		**343**	**421**	**149**	**39**		**953**	**334**	**410**	**67**	**17**		**828**	**13.3**
2B4P with Cooling	*75*	*36*	*2700*	**15.4**	**15.4**	*2310.9523*	*Natural Gas*	*2080.8298*	*Natural Gas*	*328.5844*	*75*		**499**	**449**	**171**	**39**		**1,158**	**485**	**437**	**77**	**17**		**1,016**	**13.6**
2B4P with Cooling	*80.9*	*36*	*2912.4*	**16.2**	**16.2**	*2904.3476*	*Natural Gas*	*2122.6626*	*Natural Gas*	*350.7375*	*75*		**627**	**458**	**182**	**39**		**1,307**	**610**	**446**	**82**	**17**		**1,155**	**14.3**
2B4P with Cooling	*76.8*	*36*	*2764.8*	**13.6**	**13.7**	*1754.5642*	*Natural Gas*	*2112.4615*	*Natural Gas*	*334.7862*	*75*		**379**	**456**	**174**	**39**		**1,048**	**368**	**444**	**78**	**17**		**908**	**11.8**
1B2P with Cooling	*51.6*	*37*	*1909.2*	**23.3**	**23.3**	*3030.7252*	*Natural Gas*	*1783.563*	*Natural Gas*	*239.0768*	*75*		**655**	**385**	**124**	**39**		**1,203**	**636**	**375**	**56**	**17**		**1,084**	**21.0**
2B4P with Cooling	*77.6*	*30*	*2328*	**19.3**	**19.3**	*3856.5637*	*Natural Gas*	*2080.4555*	*Natural Gas*	*338.5518*	*75*		**833**	**449**	**176**	**39**		**1,497**	**810**	**437**	**79**	**17**		**1,343**	**17.3**
Sum	**30,353**	**473**	**30,353**	**16.6**	**-**	**993,660**	**N/A**	**923,778**	**N/A**	**138,972**	**35,646**	**0**	**214,630**	**199,536**	**72,127**	**18,500**	**0**	***504,793***	**208,669**	**193,993**	**32,381**	**8,306**	**0**	***443,348***	**14.6**

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) TER - SOURCE: BRUKL OUTPUT							REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE						REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) - TER BRUKL					REGULATED CO2 EMISSIONS	
				Calculated TER 2012 (kgCO2 / m2)	BRUKL TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)
													##########	##########					##########	##########					
Resident Facility, C	*945*	*1*	*945*	**91.1**	**91.1**	*14.86*	*Natural Gas*	*295.69*	*Natural Gas*	*27.54*	*7.01*	*12.91*	**311**	**46**				**86,085**	**311**	**46**				**71,817**	**76.0**
Tesco	*9443.5*	*1.117*	*10550*	**58.9**	**52.7**	*7.67*	*Natural Gas*	*2.12*	*Natural Gas*	*48.06*	*2.85*	*49.06*	**10**	**97**				**555,921**	**10**	**97**				**261,248**	**27.7**
Sum	**10,389**	**2**	**11,495**	**68.1**	**-**	**94,949**	**94,949**	**0**	**0**	**0**	**0**	**0**	**321**	**155**	**N/A**	**N/A**	**N/A**	***707,143***	**321**	**155**	**N/A**	**N/A**	**N/A**	***363,675***	**35.0**

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m^2)	Calculated TER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION							REGULATED CO2 EMISSIONS	REGULATED CO2 EMISSIONS PER UNIT	
				Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	2012 CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
Sum	**41,848**	**29.0**	**-**	**1,088,609**		**923,778**		**138,972**	**35,646**	**0**	***1,211,936***	***807,023***	**19.3**

The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

SAP 2012 CO2 PERFORMANCE | SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)
					DER Sheet (Row 384)
1B2P with Cooling	55.6	18	1000.8	16.4	16.4
3B5P with Cooling	86.6	56	4849.6	14.3	14.3
1B1P with Cooling	40.3	19	765.7	21.9	21.9
1B2P with Cooling	50.4	138	6955.2	13.9	13.9
2B3P with Cooling	62.2	67	4167.4	14.1	14.1
2B4P with Cooling	75	36	2700	14.8	14.8
2B4P with Cooling	80.9	36	2912.4	14.7	14.7
2B4P with Cooling	76.8	36	2764.8	12.7	12.8
1B2P with Cooling	51.6	37	1909.2	20.9	20.9
2B4P with Cooling	77.6	30	2328	17.5	17.5
Sum	30,353	473	30,353	15.1	-

REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET

Unit identifier	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1B2P with Cooling	*1404.11352*	*Natural Gas*	*1858.844022*	*Natural Gas*	*279.8198*	*118.1694*	*0*
3B5P with Cooling	*2228.598101*	*Natural Gas*	*2175.079553*	*Natural Gas*	*371.5144*	*184.3846*	*0*
1B1P with Cooling	*1726.263575*	*Natural Gas*	*1665.69352*	*Natural Gas*	*192.5349*	*94.6142*	*0*
1B2P with Cooling	*611.3654749*	*Natural Gas*	*1791.754413*	*Natural Gas*	*251.0355*	*101.9129*	*0*
2B3P with Cooling	*1113.258883*	*Natural Gas*	*1941.344581*	*Natural Gas*	*287.8882*	*126.5495*	*0*
2B4P with Cooling	*1891.470168*	*Natural Gas*	*2080.777877*	*Natural Gas*	*328.5442*	*160.8901*	*0*
2B4P with Cooling	*2141.194749*	*Natural Gas*	*2132.752961*	*Natural Gas*	*350.7375*	*167.2488*	*0*
2B4P with Cooling	*1250.447374*	*Natural Gas*	*2097.516536*	*Natural Gas*	*334.7598*	*158.3483*	*0*
1B2P with Cooling	*2326.917765*	*Natural Gas*	*1807.267933*	*Natural Gas*	*238.7986*	*119.8261*	*0*
2B4P with Cooling	*2947.588715*	*Natural Gas*	*2104.708603*	*Natural Gas*	*338.5518*	*175.5494*	*0*
Sum	706,547	N/A	921,452	N/A	138,929	64,007	0

REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.) — SAP 2012 CO2 PERFORMANCE

Unit identifier	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
1B2P with Cooling	303	402	145	61	0	911
3B5P with Cooling	481	470	193	96	0	1,240
1B1P with Cooling	373	360	100	49	0	882
1B2P with Cooling	132	387	130	53	0	702
2B3P with Cooling	240	419	149	66	0	875
2B4P with Cooling	409	449	171	84	0	1,112
2B4P with Cooling	462	461	182	87	0	1,192
2B4P with Cooling	270	453	174	82	0	979
1B2P with Cooling	503	390	124	62	0	1,079
2B4P with Cooling	637	455	176	91	0	1,358
Sum	152,614	199,034	72,104	33,219	0	*456,971*

REGULATED CO2 EMISSIONS PER UNIT — SAP10 CO2 PERFORMANCE

Unit identifier	Space Heating CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	Auxiliary CO2 emissions (kgCO2 p.a.)	Cooling CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
1B2P with Cooling	295	390	65	28	0	778	14.0
3B5P with Cooling	468	457	87	43	0	1,054	12.2
1B1P with Cooling	363	350	45	22	0	779	19.3
1B2P with Cooling	128	376	58	24	0	587	11.6
2B3P with Cooling	234	408	67	29	0	738	11.9
2B4P with Cooling	397	437	77	37	0	948	12.6
2B4P with Cooling	450	448	82	39	0	1,018	12.6
2B4P with Cooling	263	440	78	37	0	818	10.7
1B2P with Cooling	489	380	56	28	0	952	18.4
2B4P with Cooling	619	442	79	41	0	1,181	15.2
Sum	148,375	193,505	32,370	14,914	0	*389,164*	12.8

DOMESTIC ENERGY DEMAND DATA

Unit identifier	Fabric Energy Efficiency (FEE): Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.): Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
1B2P with Cooling	42.26	1,404	1,859	280	118	0
3B5P with Cooling	40.85	2,229	2,175	372	184	0
1B1P with Cooling	59.39	1,726	1,666	193	95	0
1B2P with Cooling	30.57	611	1,792	251	102	0
2B3P with Cooling	34.72	1,113	1,941	288	127	0
2B4P with Cooling	40.9	1,891	2,081	329	161	0
2B4P with Cooling	42.13	2,141	2,133	351	167	0
2B4P with Cooling	32.53	1,250	2,098	335	158	0
1B2P with Cooling	59.05	2,327	1,807	239	120	0
2B4P with Cooling	51.63	2,948	2,105	339	176	0
Sum	39.51	706,547	921,452	138,929	64,007	0

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)
Resident Facility, C	*945*	*1*	*945*	80.0	80.0
Tesco	*9443.5*	*1.117*	*10550*	41.7	37.3
Sum	10,389	2	11,495	49.6	-

REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT

Building Use	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Resident Facility, C	*12.96*	*Natural Gas*	*296.51*	*Grid Electricity*	*10.89*	*8.69*	*6.46*
Tesco	*6.53*	*Natural Gas*	*2.09*	*Grid Electricity*	*29.26*	*5.33*	*33.67*
Sum	81,128	N/A	302,248	N/A	318,937	64,435	361,269

LATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV

Building Use	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)
	##############	##############				
Resident Facility, C	309	25				75,621
Tesco	9	68				393,337
Sum	319	102	N/A	N/A	N/A	*515,046*

REGULATED CO2 EMISSIONS PER UNIT

Building Use	Natural Gas	Grid Electricity	SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)
	##############	##############		
Resident Facility, C	309	25	67,005	70.9
Tesco	9	68	186,862	19.8
Sum	319	102	*275,762*	26.5

NON-DOMESTIC ENERGY DEMAND

N/A

REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)

Building Use	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Resident Facility, C	12,247	280,202	10,291	8,212	6,105
Tesco	68,892	22,050	308,693	56,232	355,219
Sum	89,199	304,831	355,101	71,023	402,884

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	41,848	23.2	-	787,675		1,223,700		457,866	128,442	361,269

Use	REGULATED CO2 EMISSIONS: 2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS: SAP10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)	N/A
Sum	*972,017*	*664,925*	15.9	

REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)

Use	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	795,746	1,226,283	494,030	135,029	402,884

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	if applicable DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	if applicable	if applicable DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1B2P with Cooling	*55.6*	*18*	*1000.8*	16.7	16.7	*556.8453789*	*Natural Gas*	*737.1830611*	*Natural Gas*	*849.2315594*	*Grid Electricity*		*279.8198*	*126.0206*	*0*
3B5P with Cooling	*86.6*	*56*	*4849.6*	14.6	14.6	*883.8206589*	*Natural Gas*	*862.5962126*	*Natural Gas*	*1146.120346*	*Grid Electricity*		*371.5144*	*195.1945*	*0*
1B1P with Cooling	*40.3*	*19*	*765.7*	22.4	22.4	*684.6041011*	*Natural Gas*	*660.5831368*	*Natural Gas*	*882.8055246*	*Grid Electricity*		*192.5349*	*102.9839*	*0*
1B2P with Cooling	*50.4*	*138*	*6955.2*	14.2	14.2	*242.4562189*	*Natural Gas*	*710.5765579*	*Natural Gas*	*625.4464633*	*Grid Electricity*		*251.0355*	*107.9464*	*0*
2B3P with Cooling	*62.2*	*67*	*4167.4*	14.4	14.4	*441.4978379*	*Natural Gas*	*769.9012253*	*Natural Gas*	*795.0044093*	*Grid Electricity*		*287.8882*	*134.2267*	*0*
2B4P with Cooling	*75*	*36*	*2700*	15.1	15.1	*750.1219937*	*Natural Gas*	*825.1979305*	*Natural Gas*	*1033.834616*	*Grid Electricity*		*328.5442*	*170.8446*	*0*
2B4P with Cooling	*80.9*	*36*	*2912.4*	15.1	15.1	*849.1581242*	*Natural Gas*	*845.8102695*	*Natural Gas*	*1112.356273*	*Grid Electricity*		*350.7375*	*177.9934*	*0*
2B4P with Cooling	*76.8*	*36*	*2764.8*	13.0	13.0	*495.9042084*	*Natural Gas*	*831.8361621*	*Natural Gas*	*871.3556754*	*Grid Electricity*		*334.7598*	*166.7868*	*0*
1B2P with Cooling	*51.6*	*37*	*1909.2*	21.4	21.4	*922.8124316*	*Natural Gas*	*716.7289474*	*Natural Gas*	*1075.981206*	*Grid Electricity*		*238.7986*	*129.4924*	*0*
2B4P with Cooling	*77.6*	*30*	*2328*	17.9	17.9	*1168.959011*	*Natural Gas*	*834.6884042*	*Natural Gas*	*1314.932938*	*Grid Electricity*		*338.5518*	*187.4502*	*0*
Sum	30,353	473	30,353	15.4	-	280,203	N/A	365,431	N/A	423,710	N/A	0	138,929	68,023	0

Unit identifier (e.g. plot number, dwelling type etc.)	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
1B2P with Cooling	120	159	441		145	65	0	931
3B5P with Cooling	191	186	595		193	101	0	1,266
1B1P with Cooling	148	143	458		100	53	0	902
1B2P with Cooling	52	153	325		130	56	0	717
2B3P with Cooling	95	166	413		149	70	0	893
2B4P with Cooling	162	178	537		171	89	0	1,136
2B4P with Cooling	183	183	577		182	92	0	1,218
2B4P with Cooling	107	180	452		174	87	0	999
1B2P with Cooling	199	155	558		124	67	0	1,104
2B4P with Cooling	252	180	682		176	97	0	1,388
Sum	60,524	78,933	219,906	0	72,104	35,304	0	*466,770*

Unit identifier (e.g. plot number, dwelling type etc.)	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
1B2P with Cooling	117	155	198		65	29	0	564	10.1
3B5P with Cooling	186	181	267		87	45	0	766	8.8
1B1P with Cooling	144	139	206		45	24	0	557	13.8
1B2P with Cooling	51	149	146		58	25	0	430	8.5
2B3P with Cooling	93	162	185		67	31	0	538	8.6
2B4P with Cooling	158	173	241		77	40	0	688	9.2
2B4P with Cooling	178	178	259		82	41	0	738	9.1
2B4P with Cooling	104	175	203		78	39	0	599	7.8
1B2P with Cooling	194	151	251		56	30	0	681	13.2
2B4P with Cooling	245	175	306		79	44	0	850	10.9
Sum	58,843	76,740	98,724	0	32,370	15,849	0	*282,527*	9.3

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water			Total Electricity generated by CHP (-)	Lighting	Auxiliary	Cooling
												if applicable			
Resident Facility, C	*945*	*1*	*945*	68.6	68.7	*4.17*	*Natural Gas*	*160.22*	*Natural Gas*				*10.89*	*8.69*	*6.46*
Tesco	*9443.5*	*1.117*	*10550*	40.9	36.6	*1.42*	*Grid Electricity*	*2.07*	*Natural Gas*				*29.26*	*5.33*	*33.67*
Sum	10,389	2	11,495	47.8	-	18,919	N/A	173,243	N/A	N/A	N/A	0	318,937	64,435	361,269

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	2012 CO2 emissions (kgCO2 p.a.)
	##############	##############	##############	##############	
Resident Facility, C	99	91			64,836
Tesco	2	70			386,188
Sum	101	169	0	0	*496,273*

Building Use	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	SAP 10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)
	##############	##############	##############	##############		
Resident Facility, C	99	91			39,643	41.9
Tesco	2	70			175,843	18.6
Sum	101	169	0	0	*236,089*	22.7

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	41,848	23.0	-	299,123	N/A	538,674	N/A	423,710	N/A	0	457,866	132,458	361,269

Use	REGULATED CO2 EMISSIONS: 2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: SAP 10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)
Sum	*963,043*	*518,617*	12.4

SAP 2012 PERFORMANCE

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	505	585
After energy demand reduction	457	585
After heat network / CHP	467	585
After renewable energy	467	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	48	9%
Savings from heat network / CHP	-10	-2%
Savings from renewable energy	0	0%
Cumulative on site savings	**38**	**8%**
Annual savings from off-set payment	467	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**14,003**	-
Cash in-lieu contribution (£)	**840,187**	

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	389	263
After heat network / CHP	283	263
After renewable energy	283	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	54	12%
Savings from heat network / CHP	107	24%
Savings from renewable energy	0	0%
Cumulative on site savings	**161**	**36%**
Annual savings from off-set payment	283	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**8,476**	-
Cash in-lieu contribution (£)	**508,549**	

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	496	816
After renewable energy	496	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	19	3%
Savings from renewable energy	0	0%
Total Cumulative Savings	**211**	**30%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**248**	-
Shortfall	37	1,099
Cash in-lieu contribution (£)	**65,934**	-

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	236	366
After renewable energy	236	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	40	11%
Savings from renewable energy	0	0%
Total Cumulative Savings	**128**	**35%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	127	-
Shortfall	0	-9
Cash in-lieu contribution (£)	**-539**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	1,212		
Be lean	972	240	20%
Be clean	963	9	1%
Be green	963	0	0%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**15,102**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	807		
Be lean	665	142	18%
Be clean	519	146	18%
Be green	519	0	0%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**8,467**	-

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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	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 [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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^2K]	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	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	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"

$U_{i\text{-}Typ}$ = 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

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 [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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 Green

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 13:19:15 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, $kgCO_2/m^2.annum$	81.8
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	81.8
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	68.4
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 [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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/Gas Boiler

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1.69	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 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- Heat pump/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	6.99	8.36
Cooling	6.46	12.91
Auxiliary	8.69	7.01
Lighting	10.89	27.54
Hot water	159.94	166.31
Equipment*	41.02	41.02
TOTAL**	**192.97**	**222.12**

* 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/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]	398.89	477.64
Total emissions [kg/m^2]	68.4	81.8

* 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	7	6.5	8.7	1.57	4.62	1.69	6.5
	Notional	43.8	167.3	8.4	12.9	7	1.46	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 - 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"

$U_{i\text{-}Typ}$ = 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

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 [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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
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

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September 2020

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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.	

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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.

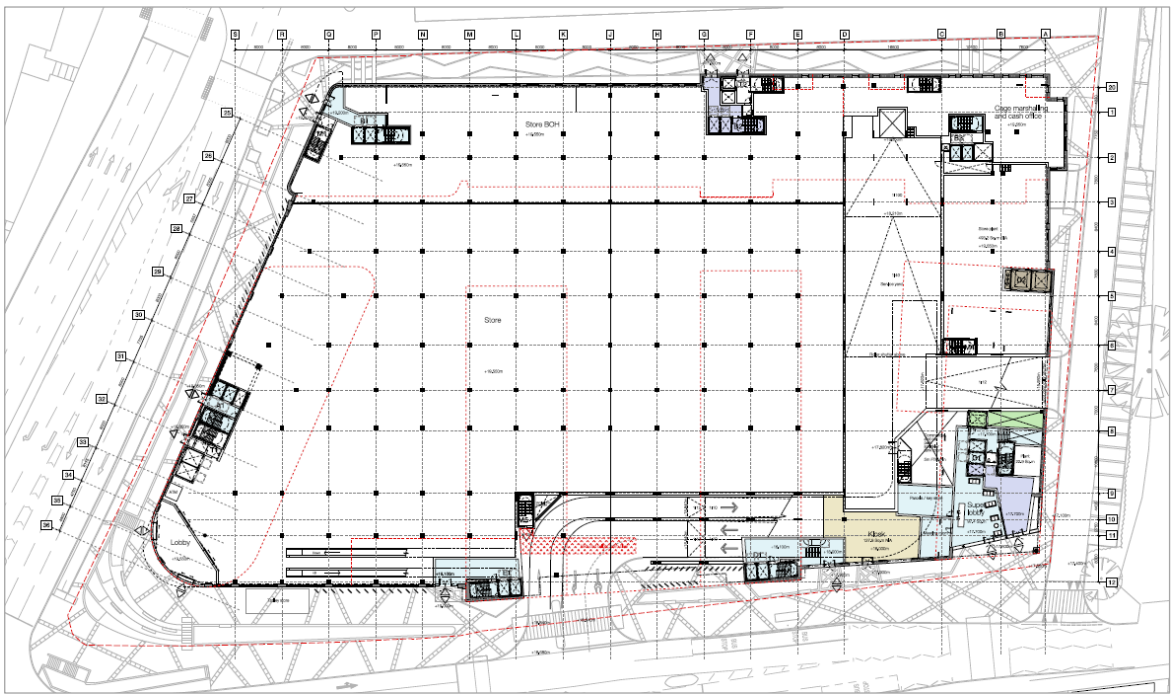


Figure 2: Ground Floor level (Patel Taylor 28.08.2020)

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.

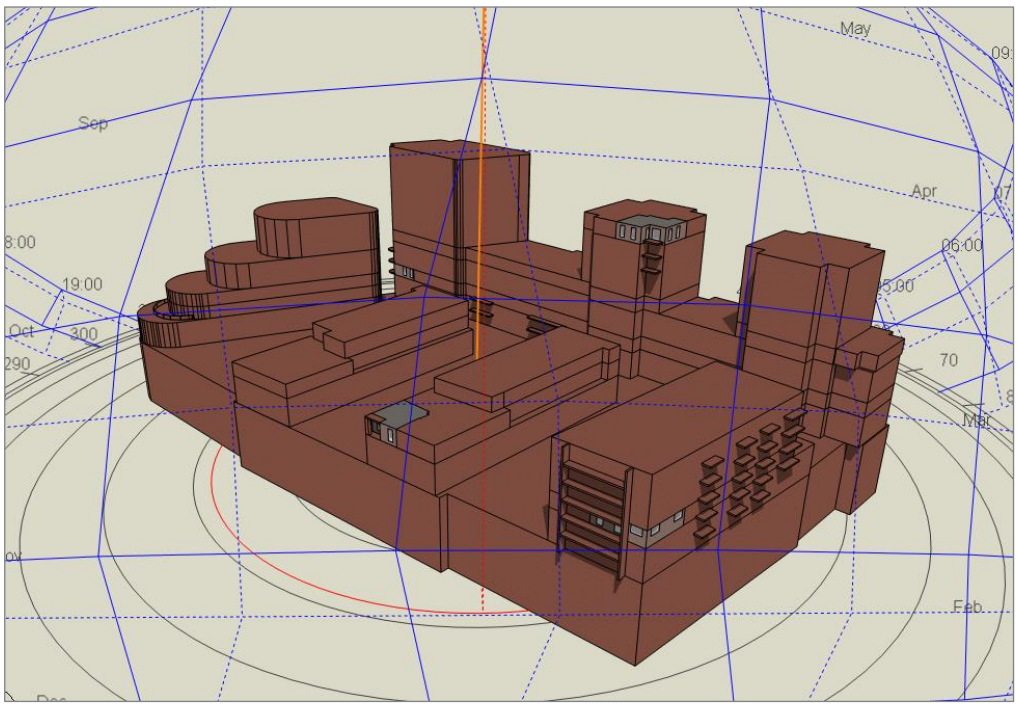


Figure 4: Sun path diagram (Source: Design builder simulation model, 21t June 12:00).

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/m^2/K	*Thermally massive construction assumed. As per Planning Energy Statement.*
	Ground floor	0.10 W/m^{2}K	*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/m^{2}K	*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 60^0C and 30^0C 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.

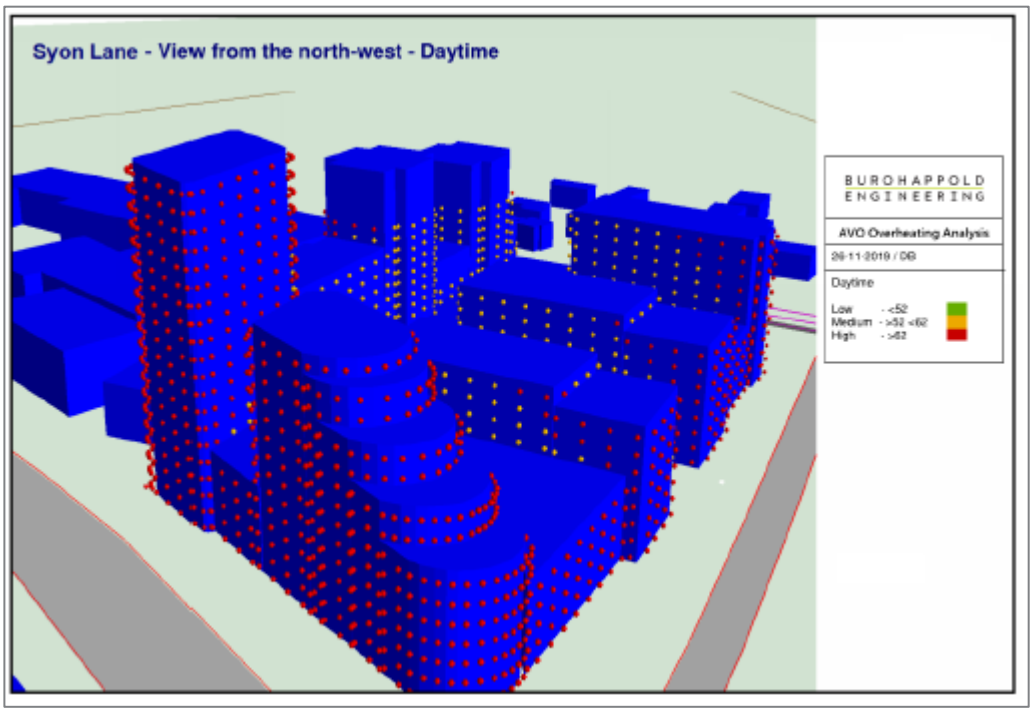


Figure 5: AVO overheating model noise level on the north-west façade during daytime (Source: Buro Happold Noise Design Note)

Figure 6: Natural ventilation strategy mark-up daytime based on noise modelling results.

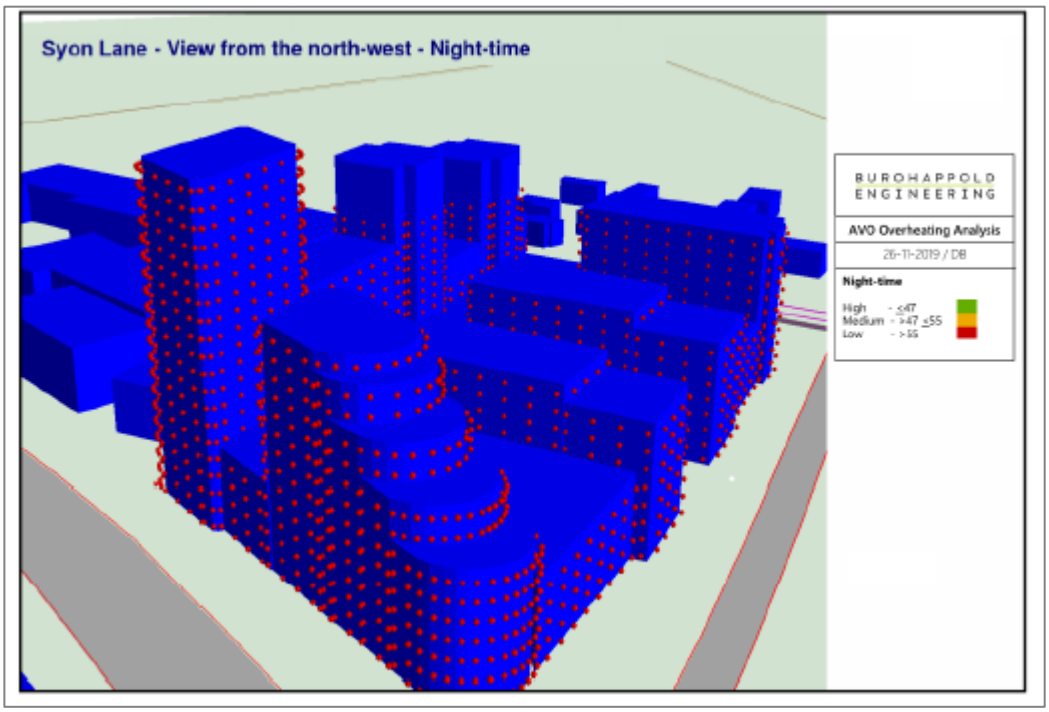


Figure 7: AVO overheating model noise level on the north-west façade during night-time (Source: Buro Happold Noise Design Note)

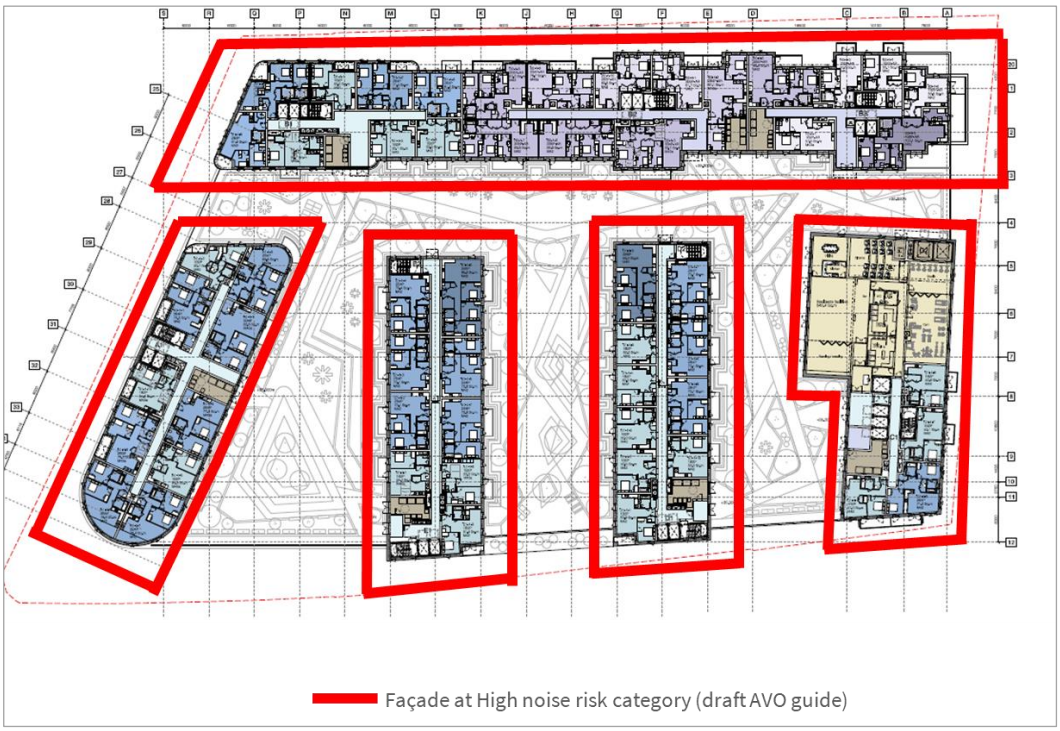


Figure 8: Natural ventilation strategy mark-up night-time based on noise modelling results.

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.

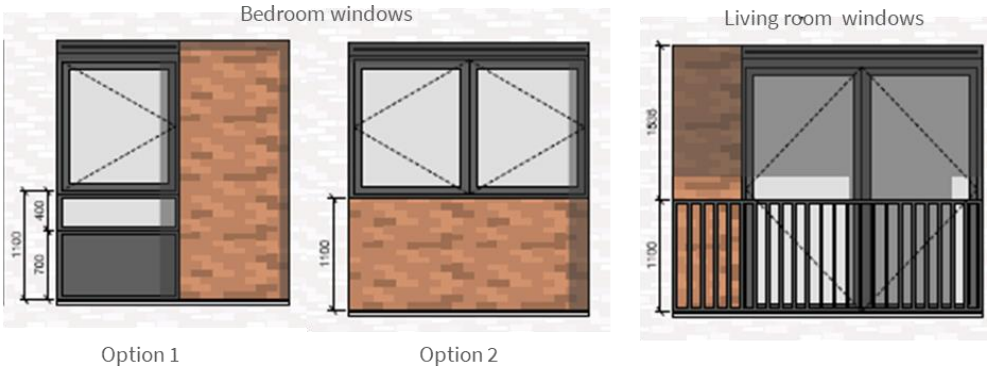


Figure 9. Windows design options tested (Source: Patel Taylor Architects architectural drawings received on 19.08.2019 (initial design) and 10.12.2019).

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)

		Balconies in front of kitchen/living rooms			Balconies between rooms		
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)
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.

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.

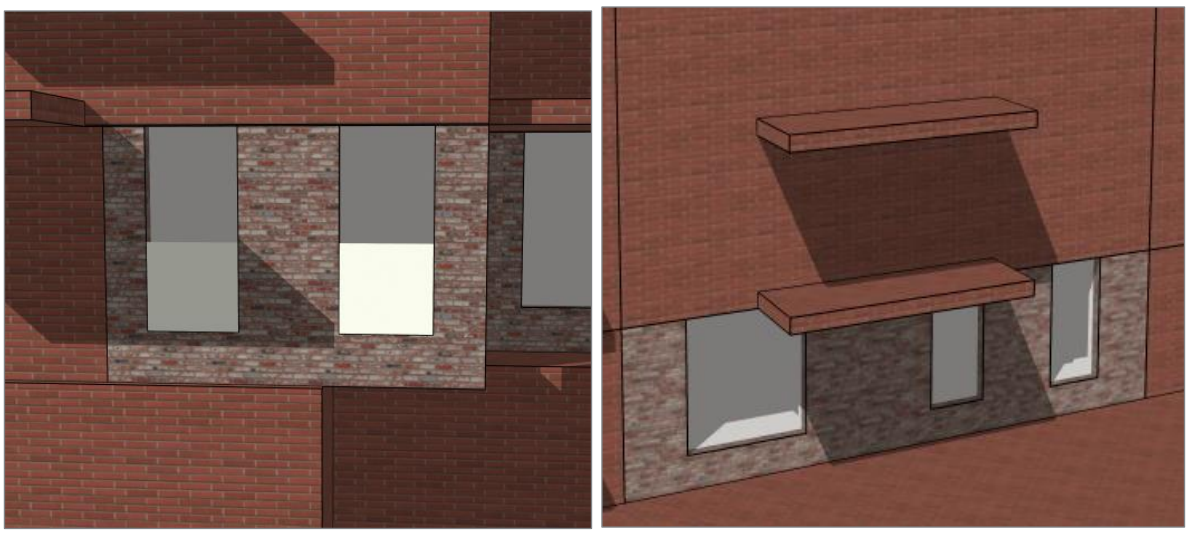


Figure 11. Left: Windows with higher sill and bottom panel on Block B. Right: shade provided by a balcony in between kitchen/living room and bedrooms in Block D (View of the model).

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 28°C. 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.	

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

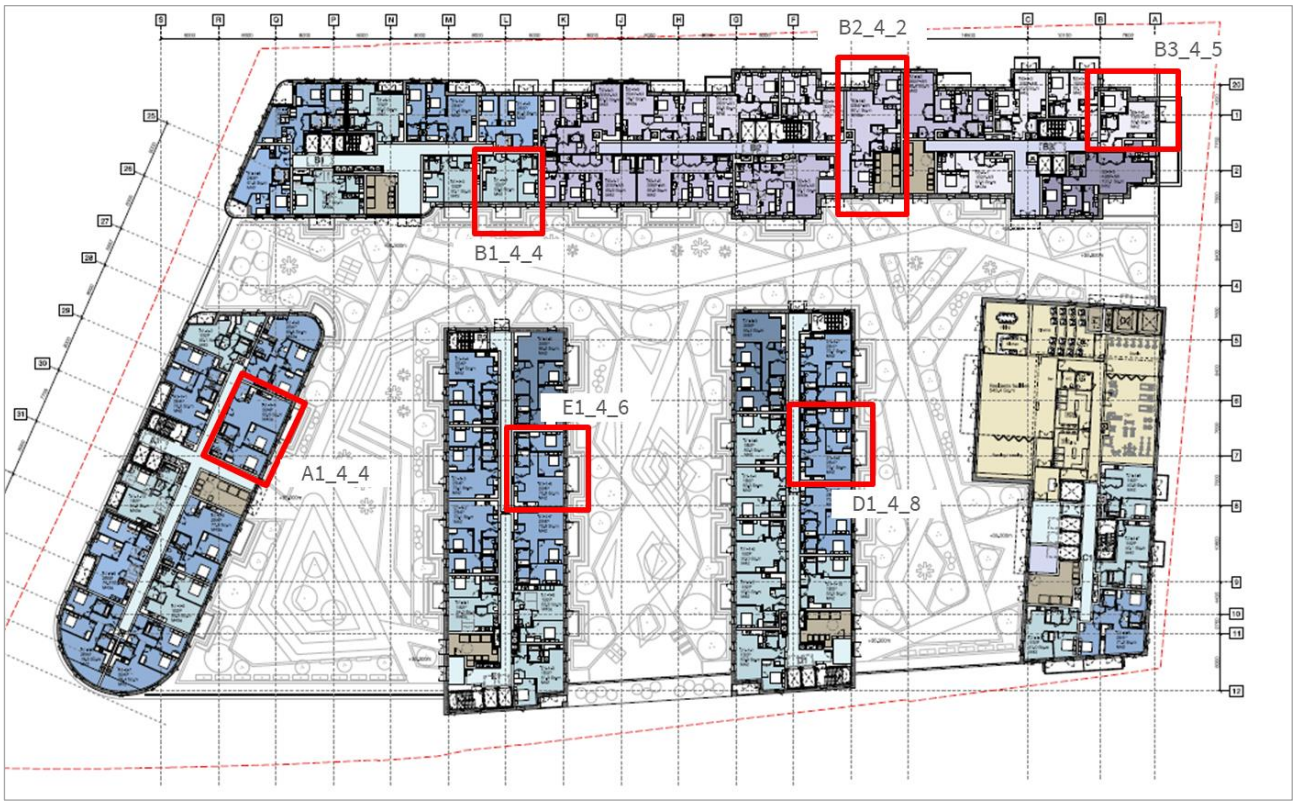


Figure F1.1: 4th floor typical floor plan indicating selected units tested (Source: Patel Taylor Architects received on 20.07.2020).

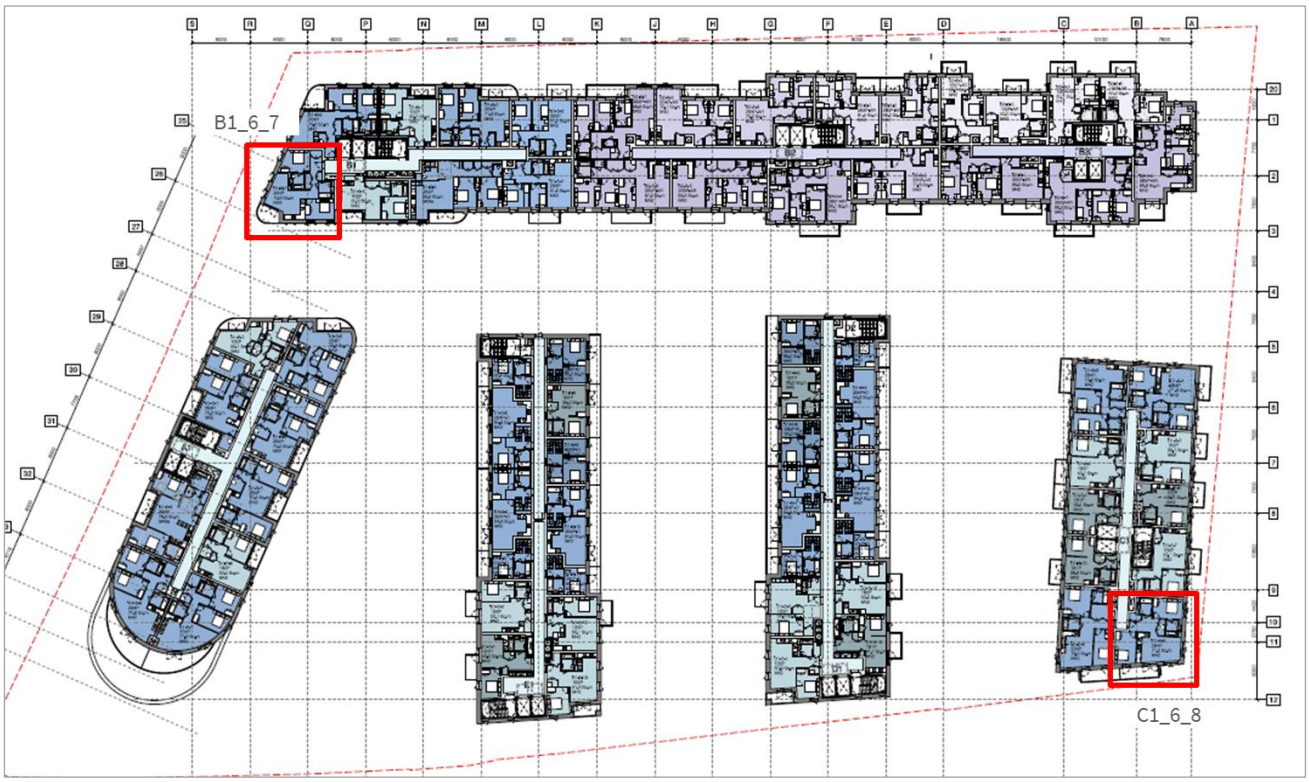


Figure F1.2: 6th floor typical floor plan indicating two units tested (Source: Patel Taylor Architects received on 20.07.2020).

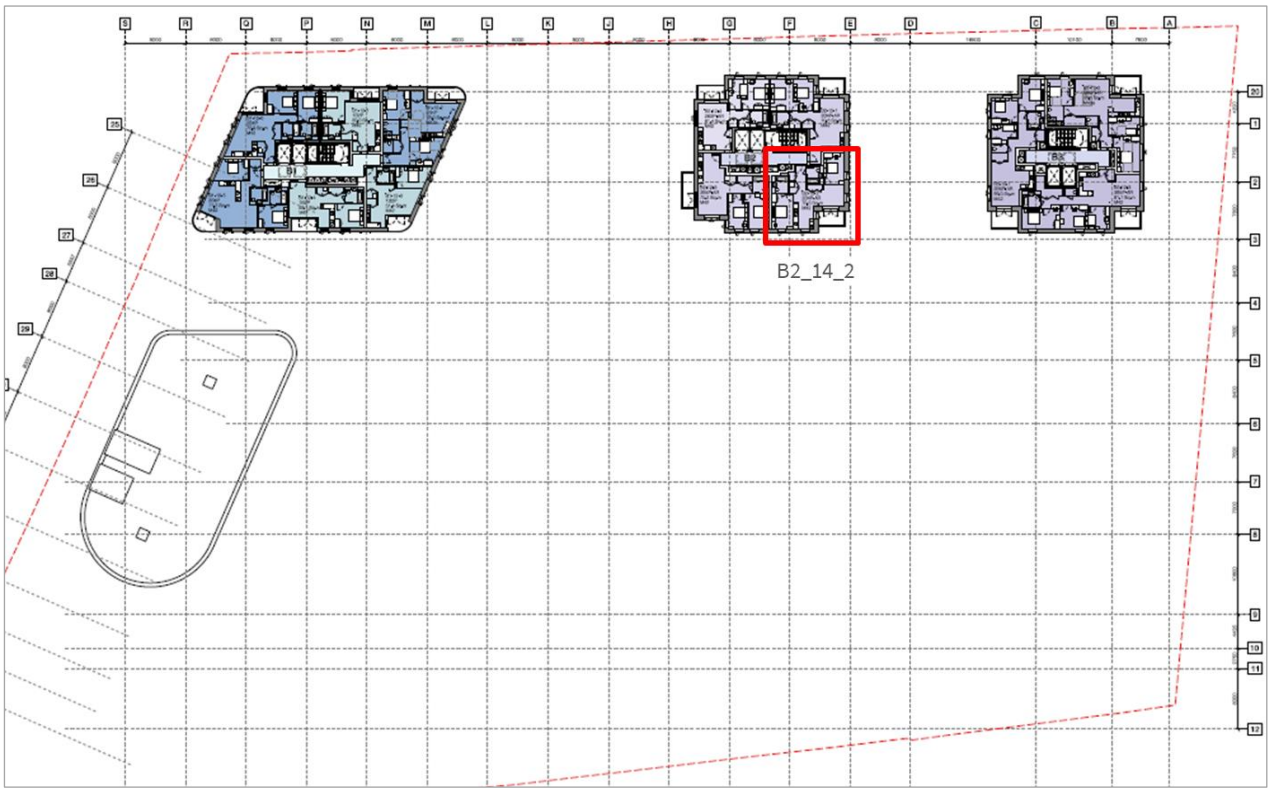


Figure F1.3: 14th floor typical floor plan indicating two units tested (Source: Patel Taylor Architects received on 20.07.2020).

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**	
SE – Dual aspect	C1.06.08	LDK	0.00	N/A	Pass
		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

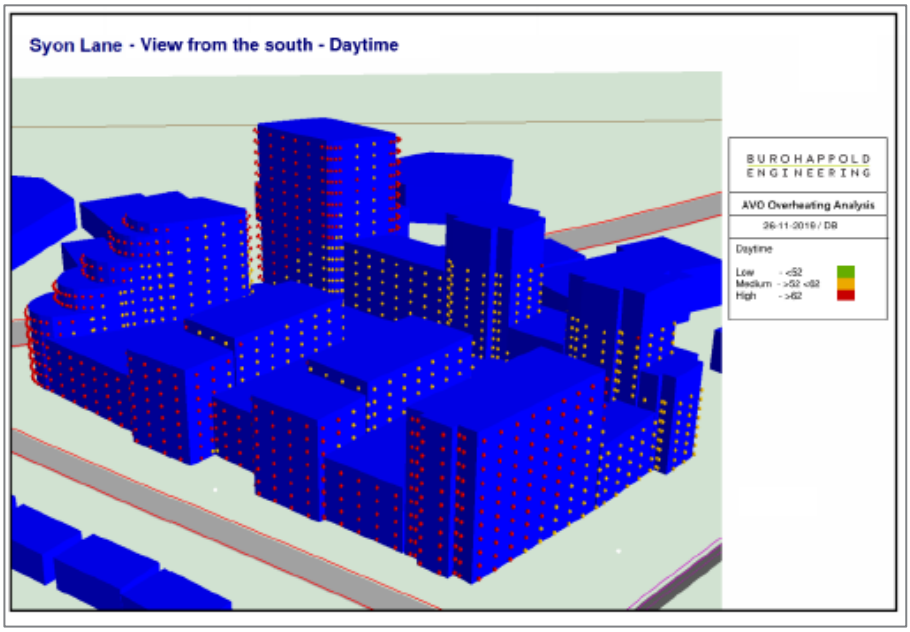


Figure F3.1: AVO overheating model noise level on the south façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

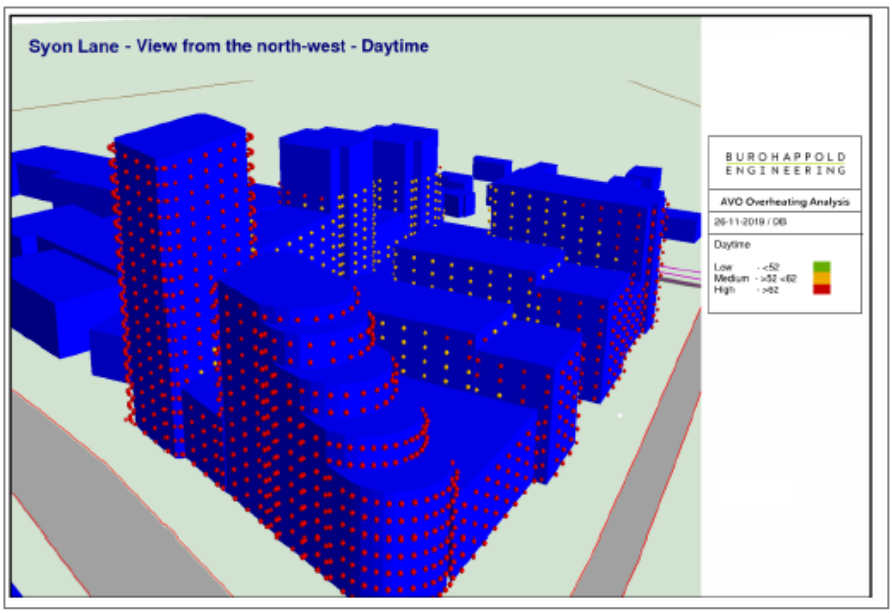


Figure F3.2: AVO overheating model noise level on the North-west façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

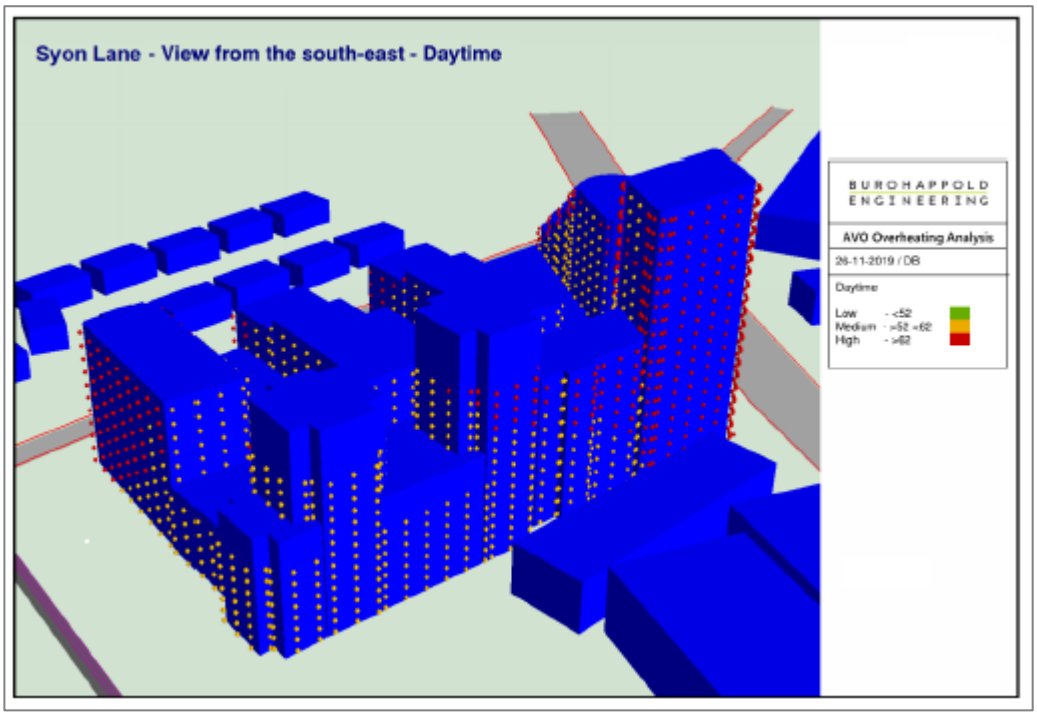


Figure F3.3: AVO overheating model noise level on the south-east façade during daytime (Source: Buro Happold Noise Design Note, December 2019)

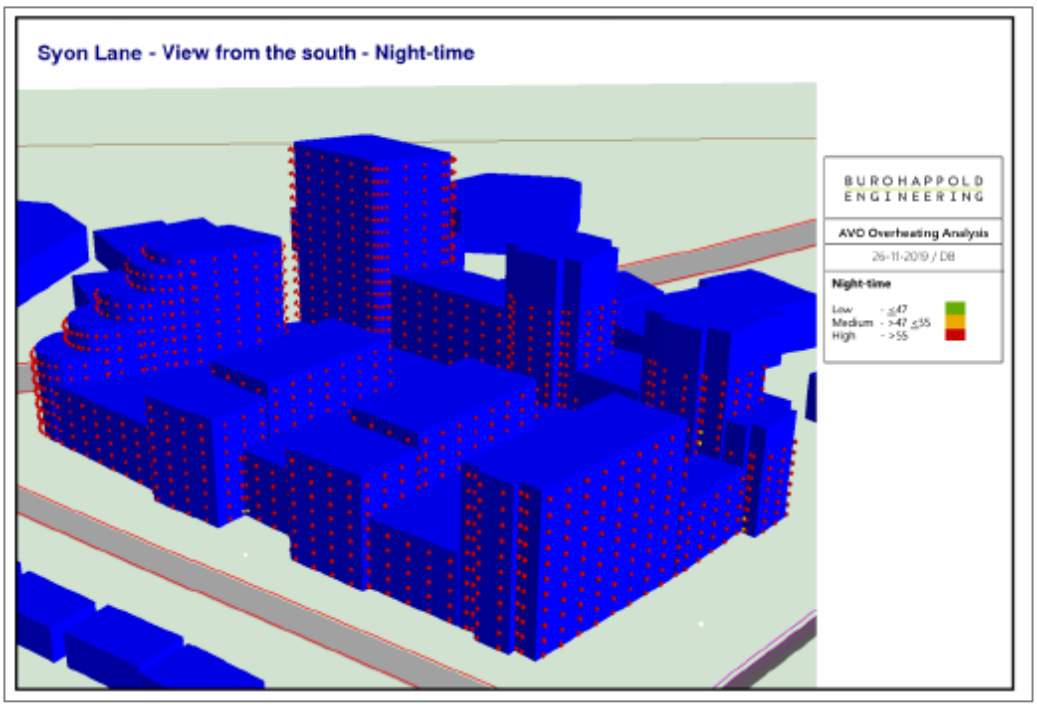


Figure F3.4: AVO overheating model noise level on the south façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

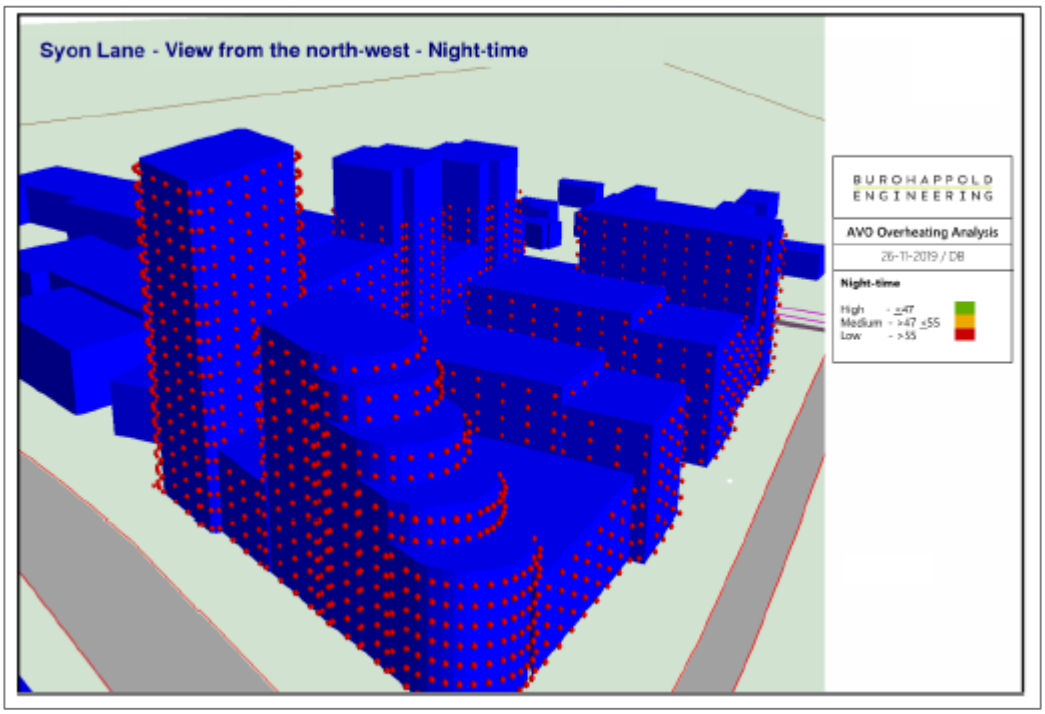


Figure F3.5: AVO overheating model noise level on the North-west façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

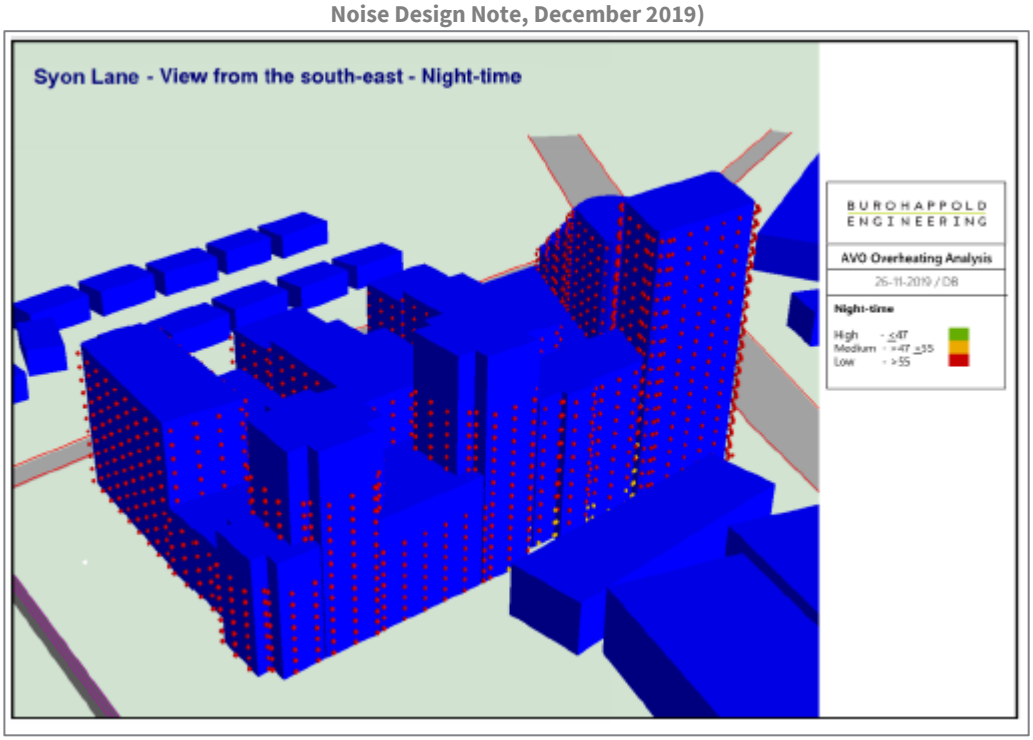


Figure F3.6: AVO overheating model noise level on the south-east façade during night-time (Source: Buro Happold Noise Design Note, December 2019)

Figure F3.7: Natural ventilation strategy mark-up daytime based on noise modelling results.

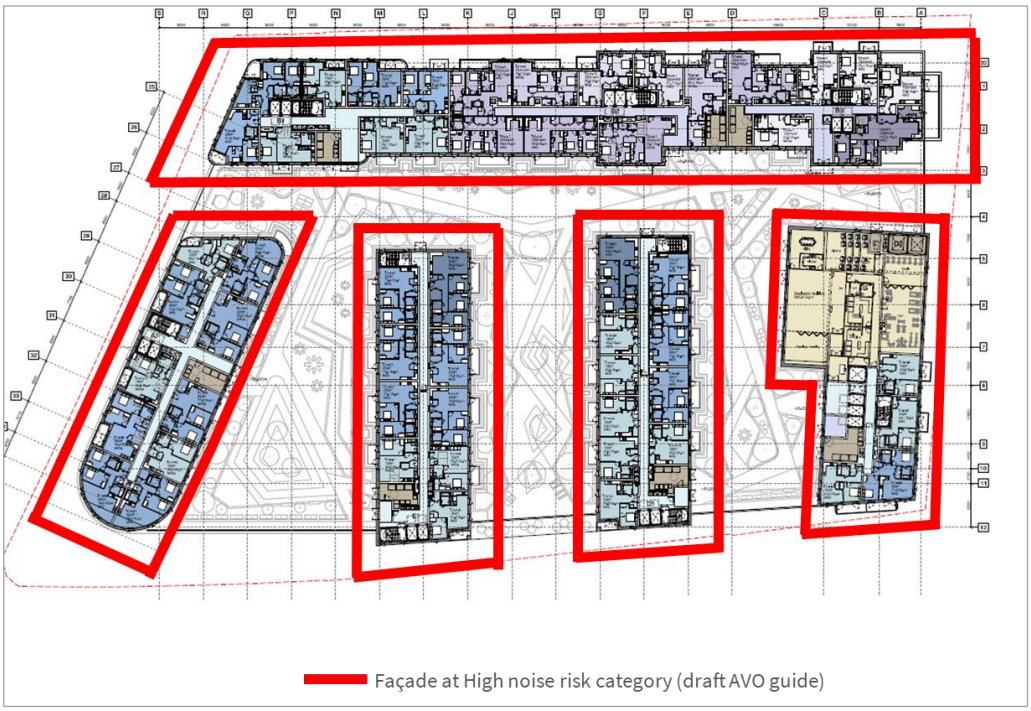


Figure F3.8: Natural ventilation strategy mark-up night-time based on noise modelling results.

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

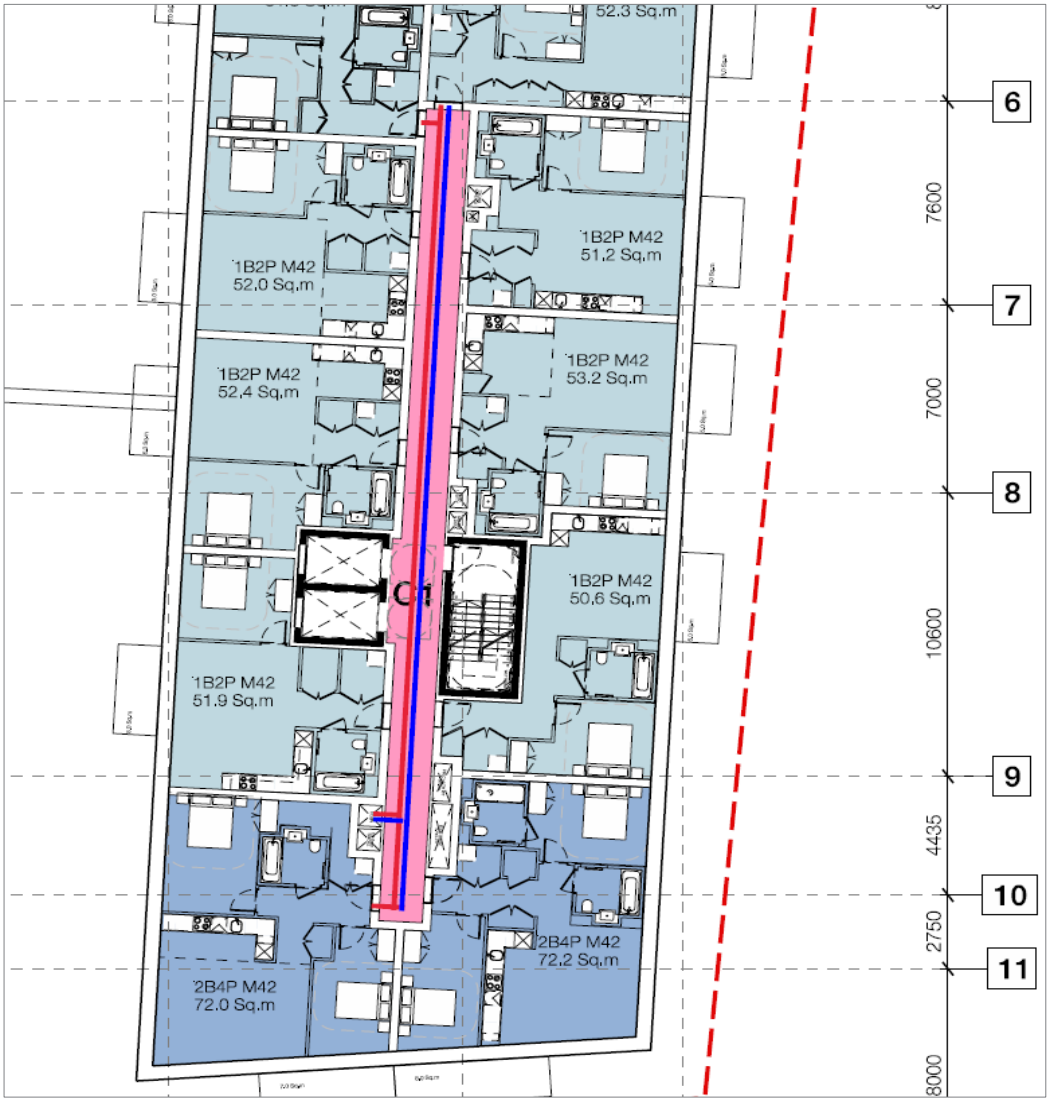


Figure F4.2: Schematic diagram of the location of the heating pipework within the corridor void of Block C 7th floor.

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**

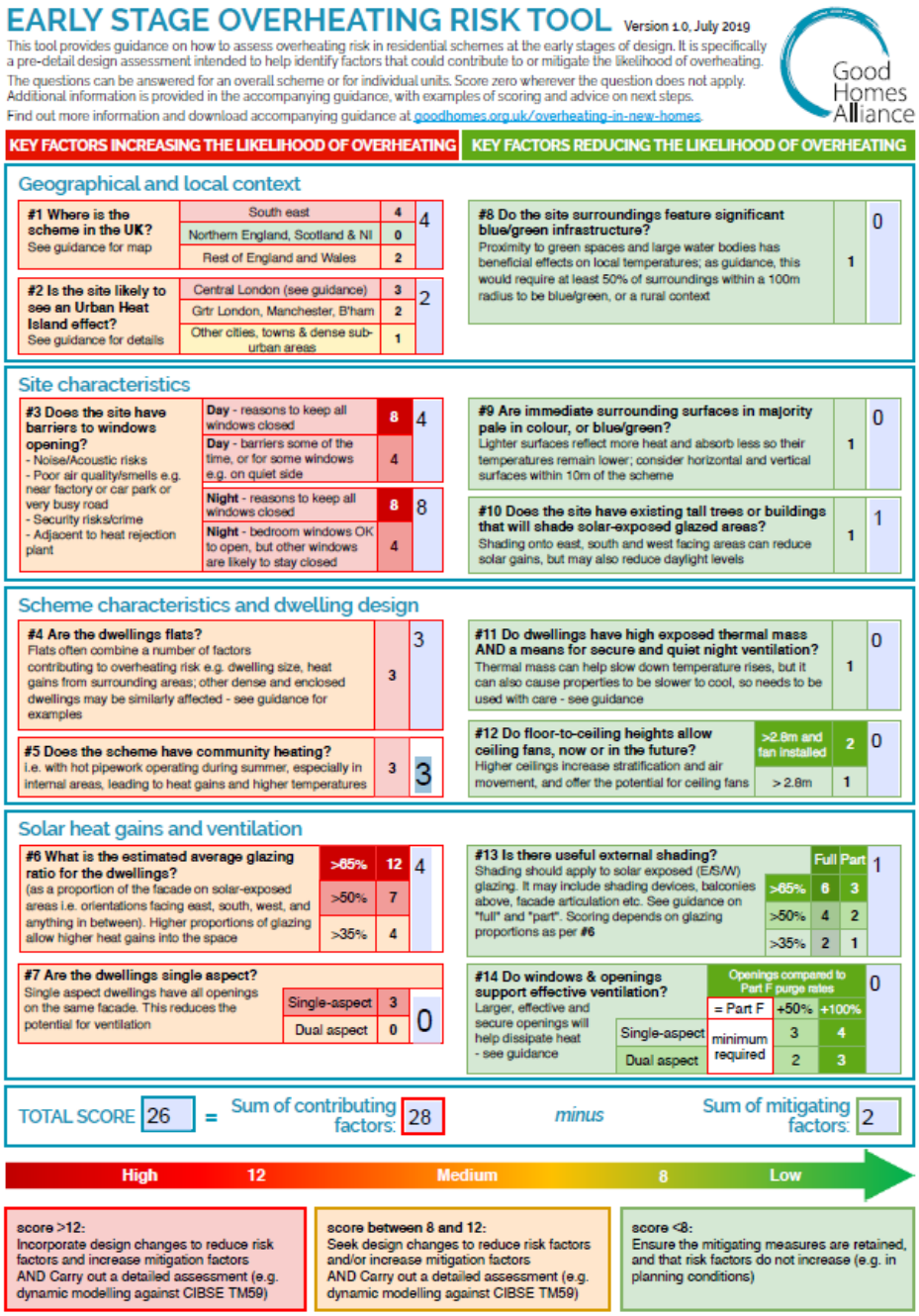
Table F5.1: Capacity of mechanical system for Minimum Part F requirements						
Dwelling	**E1.4.6**	**B1.6.7**	**C1.6.8**	**B2.14.2**		
Floor Area (m^2)	72.8	70.9	71	70.3		
Storey height (m)	2.5	2.5	2.5	2.5		
Volume (m^3)	182	177.25	177.5	175.75		
Minimum high rate (l/s)						
Kitchen	13	13	13	13		
Utility 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 (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)*	58.19	36.81	60.49	35.07	48.68	
Whole dwelling ventilation rate (m^3/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



EARLY STAGE OVERHEATING RISK TOOL Version 1.0, July 2019

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

Good Homes Alliance

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map
- South east: 4
- Northern England, Scotland & NI: 0
- Rest of England and Wales: 2

→ 4

#2 Is the site likely to see an Urban Heat Island effect? See guidance for details
- Central London (see guidance): 3
- Grtr London, Manchester, B'ham: 2
- Other cities, towns & dense sub-urban areas: 1

→ 2

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context: 1 → 0

Site characteristics

#3 Does the site have barriers to windows opening?
- Noise/Acoustic risks
- Poor air quality/smells e.g. near factory or car park or very busy road
- Security risks/crime
- Adjacent to heat rejection plant

Day - reasons to keep all windows closed: 8
Day - barriers some of the time, or for some windows e.g. on quiet side: 4 → 4

Night - reasons to keep all windows closed: 8
Night - bedroom windows OK to open, but other windows are likely to stay closed: 4 → 8

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme: 1 → 0

#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels: 1 → 1

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples: 3 → 3

#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures: 3 → 3

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance: 1 → 0

#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans
- >2.8m and fan installed: 2
- > 2.8m: 1

→ 0

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space
- >85%: 12
- >50%: 7
- >35%: 4

→ 4

#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation
- Single-aspect: 3
- Dual aspect: 0

→ 0

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per #6

	Full	Part
>85%	6	3
>50%	4	2
>35%	2	1

→ 1

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance

	Openings compared to Part F purge rates		
	= Part F minimum required	+50%	+100%
Single-aspect		3	4
Dual aspect		2	3

→ 0

TOTAL SCORE 26 = Sum of contributing factors: 28 *minus* Sum of mitigating factors: 2

High 12 Medium 8 Low

score >12: Incorporate design changes to reduce risk factors and increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

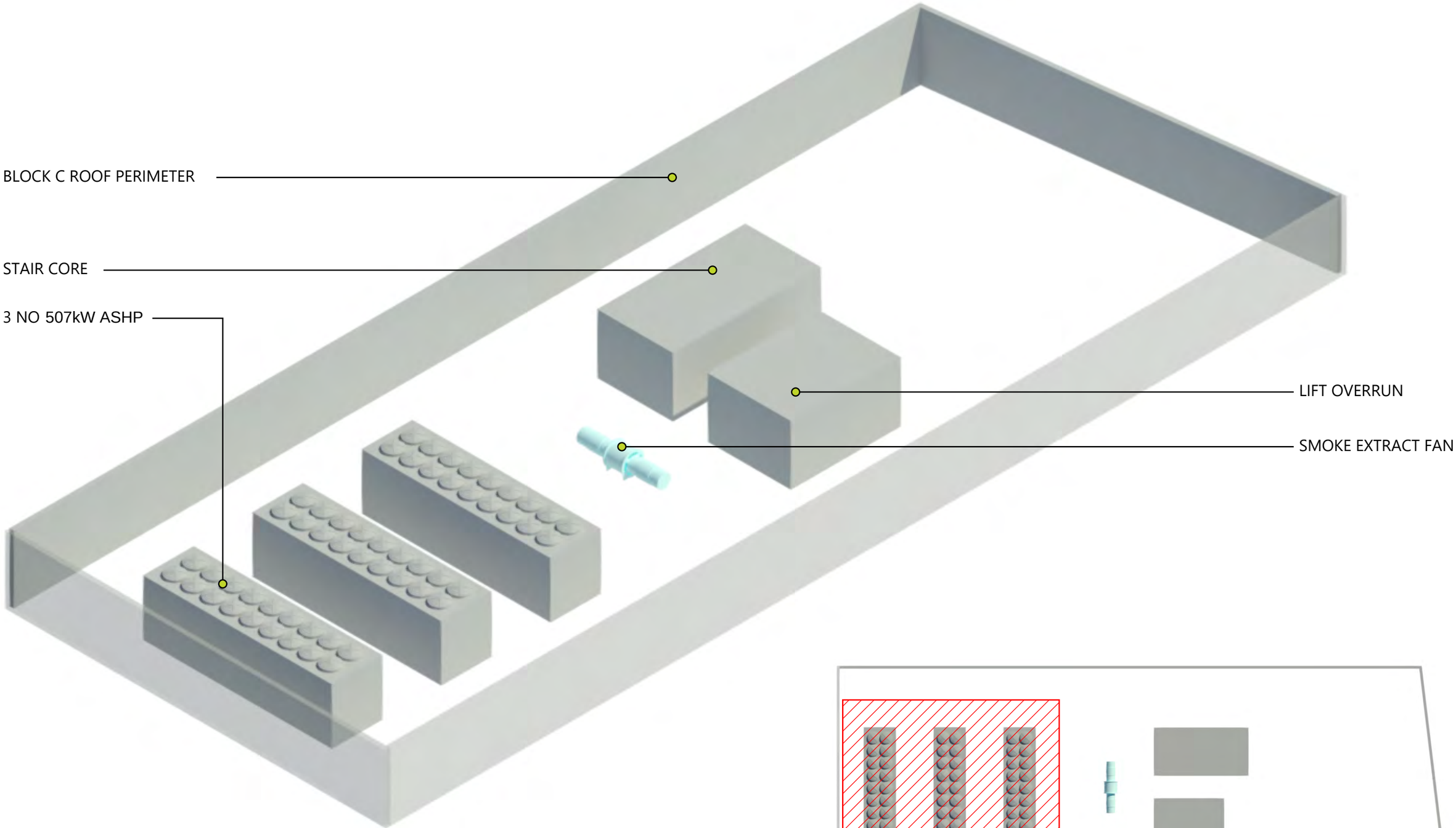
score between 8 and 12: Seek design changes to reduce risk factors and/or increase mitigation factors AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8: Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

Figure F6.1: GHA Overheating Risk Tool scoresheet.

Appendix G

Indicative ASHP Roof Plant Layout



BUROHAPPOLD ENGINEERING	Project: Syon Lane	Project Number: 0043478	Status: Stage 2		
	Sketch Title: ASHP Roof Plant Layout (Block C)	Sketch Number: SK-M-04	Date: 22/07/20	Initials: MB	Revision: 02

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Appendix H

Indicative ASHP Data Sheets

EWYT650B-XRA2+ OP142C

> Air to water reversible heat pump
> Scroll compressor
> High efficiency version
> Reduced sound configuration
> R-32 refrigerant

Unit description: Daikin air to water reversible heat pump with hermetic scroll compressors and R32 refrigerant. Unit colour is ivory White (Munsell code 5Y7.5/1) (±RAL7044).

Compressors: Hermetic orbiting scroll designed for R32 operation and complete with motor over-temperature and over-current protection devices. Each compressor is equipped with an oil heater that keeps the oil from being diluted by the refrigerant when the chiller is not running. The compressors are connected in Tandem or Trio configuration on each refrigerant circuit. Each compressor is mounted on rubber antivibration mounts for a quite operation. Unit is delivered with complete oil charge.

Water side Heat Exchanger: The unit is equipped with a direct expansion plate to plate heat exchanger. This heat exchanger is made of stainless-steel brazed plates and covered with a 20mm closed cell insulation material. The exchanger is equipped with an electric heater for protection against freezing. Water connections are provided with Victaulic kit.

Air side Heat Exchanger: The air side heat exchanger is manufactured with internally enhanced seamless copper tubes arranged in a staggered row pattern and mechanically expanded into lanced and rippled aluminum fins with full fin collars. An integral sub-cooler circuit provides sub-cooling to effectively eliminate liquid flashing and increase cooling capacity without increasing the power input.

Air side Heat Exchanger fans: The fans are propeller type with high efficiency design blades to maximize performances. Fan blades are made of glass reinforced resin and each fan is protected by a guard. Parallel Coil units are equipped as standard with fan speed modulation (phase cut). Double V Coil units (standard and low sound versions) are equipped with on/off fans and inverter drive is available as an option. Double V Coil units reduced noise versions are equipped with inverter driven fans as standard.

Refrigerant circuit: Each unit has one or two independent refrigerant circuits and each one includes: Compressors, Refrigerant, Water Side Heat Exchanger, Air Side Heat Exchanger, Electronic expansion valve, 4-way valve, Sight glass with moisture indicator, Filter drier, Charging valves, High pressure switch, High pressure transducers, Low pressure transducers, Oil pressure transducer and Suction temperature sensor.

Electrical panel: Power and control are in the main panel that is manufactured to ensure protection against all weather conditions. It is IP54 and internally protected against possible accidental contact with live parts when the doors are open. The main panel is fitted with interlocked main switch door that interrupts power supply when opening.

Controller: Latest generation MicroTech 4 controller provides an easy to use control environmental. The control logic is designed to provide maximum efficiency, to continue operation in unusual operating conditions and to provide a history of unit operation. Sophisticated software with adaptive logic selects the most energy efficient combination of compressor load, electronic expansion valve position and fans to keep stable operating conditions and maximize chiller efficiency and reliability. One of the greatest benefits is the easy interface with LonWorks, Bacnet, Ethernet TCP/IP or Modbus communications.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Cooling mode performances

Cooling capacity	613.3 kW	Chilled water IN/OUT	12.00 °C / 7.00 °C
Power input	204.3 kW	Chilled water flow	29.25 l/s
EER Cooling Efficiency	3.001 kW / kW	Water heat exchanger pressure drops	45.4 kPa
		Ambient temperature	35.0 °C
		Lw / Lp @ 1m	95 dB(A) / 74 dB(A)
SEER / ηs	4.72 / 185.8%	Fluid	Water
		Water heat exchanger fouling factor	0.000 m2°C/W

SEER declared according to EN14825, fan coil application 12/7°C (inlet/outlet) water temperatures. Sound power level according to ISO 9614-1. SEER and IPLV.IP refer to standard unit without options

Heating mode performances

Heating capacity	507.6 kW	Heated water IN/OUT	30.00 °C / 37.00 °C
Power input	166.1 kW	Heated water flow	17.35 l/s
COP Heating Efficiency	3.057 kW / kW	Water heat exchanger pressure drops	17.7 kPa
SCOP / ηs	3.880 / 152.2%	Ambient temperature	-3.0 °C

SCOP declared according to EN14825, average climate, low temperature application

Unit information

Compressor type	Scroll	Refrigerant type	R32
Capacity control	STEP	Air heat exchanger type	HFP
Compressor N°	6	Air heat exchanger fans N°	14
Circuit N°	2	Air heat exchanger fans control	BRS
Refrigerant charge	158 kg	Altitude	000 MSL
		Water heat exchanger type	Plated Heat Exchanger

Actual refrigerant charge depends on the final unit construction, refer to unit nameplate.

Electrical information

Power supply	400 V / 50.0 Hz / 3 Ph	Max. inrush current	830 A
Running current	346.94 A	Compressor starting method	Direct on line
Max. Running current	497 A		
Max. current wires sizing	546.7 A		

Voltage tolerance ± 10%. Phase Voltage unbalance ± 3%. Electrical data referred to standard unit without options, refer to unit name plate data.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Acoustic information

Sound pressure level at 1 m from the unit (rif. 2 x 10-5 Pa)

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	db(A)
84.0	78.0	77.0	75.0	70.0	65.0	59.0	59.0	**74.2**

Values referred to Evap. IN/OUT 12/7°C and 35°C Amb., full load operation, standard unit configuration without options. Sound pressure level calculated from sound power level. Sound pressure in octave band is for information only and not considered binding.

Physical information

Evap. connections size	**88.9 mm**	Length	**6825 mm**
		Width	**2282 mm**
Weight shipping/operating	**5020 kg / 5090 kg**	Height	**2514 mm**

Information referred to standard unit configuration without options, refer to certified unit drawing.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Certification notes

Within the scope of AHRI Air-Cooled Water-Chilling Packages Certification Program. AHRI Certified performance may be obtained from the manufacturer's representative

General notes

For more information about the above selected product, please go to http://www.daikineurope.com/industrial/. Unit performances are reproducible in laboratory test environment only in accordance to recognized industry standards. This technical data sheet is generated by Daikin Applied Tool software designed and distributed by Daikin Applied Europe S.p.A. The present software does not constitute an offer binding upon Daikin Applied Europe S.p.A who compiled the content of this software to the best of its knowledge. No express or implied warranty is given for the completeness, accuracy, reliability or fitness for particular purpose of its content and the products and services presented therein. Specifications are subject to change without prior notice. Daikin Applied Europe S.p.A. explicitly rejects any liability for any direct or indirect damage, in the broadest sense, arising from or related to the use and/or interpretation of this document. All content is copyrighted by Daikin Applied Europe S.p.A.

EWYT650B-XRA2+ OP142C

> Air to water reversible heat pump
> Scroll compressor
> High efficiency version
> Reduced sound configuration
> R-32 refrigerant

Unit description: Daikin air to water reversible heat pump with hermetic scroll compressors and R32 refrigerant. Unit colour is ivory White (Munsell code 5Y7.5/1) (±RAL7044).

Compressors: Hermetic orbiting scroll designed for R32 operation and complete with motor over-temperature and over-current protection devices. Each compressor is equipped with an oil heater that keeps the oil from being diluted by the refrigerant when the chiller is not running. The compressors are connected in Tandem or Trio configuration on each refrigerant circuit. Each compressor is mounted on rubber antivibration mounts for a quite operation. Unit is delivered with complete oil charge.

Water side Heat Exchanger: The unit is equipped with a direct expansion plate to plate heat exchanger. This heat exchanger is made of stainless-steel brazed plates and covered with a 20mm closed cell insulation material. The exchanger is equipped with an electric heater for protection against freezing. Water connections are provided with Victaulic kit.

Air side Heat Exchanger: The air side heat exchanger is manufactured with internally enhanced seamless copper tubes arranged in a staggered row pattern and mechanically expanded into lanced and rippled aluminum fins with full fin collars. An integral sub-cooler circuit provides sub-cooling to effectively eliminate liquid flashing and increase cooling capacity without increasing the power input.

Air side Heat Exchanger fans: The fans are propeller type with high efficiency design blades to maximize performances. Fan blades are made of glass reinforced resin and each fan is protected by a guard. Parallel Coil units are equipped as standard with fan speed modulation (phase cut). Double V Coil units (standard and low sound versions) are equipped with on/off fans and inverter drive is available as an option. Double V Coil units reduced noise versions are equipped with inverter driven fans as standard.

Refrigerant circuit: Each unit has one or two independent refrigerant circuits and each one includes: Compressors, Refrigerant, Water Side Heat Exchanger, Air Side Heat Exchanger, Electronic expansion valve, 4-way valve, Sight glass with moisture indicator, Filter drier, Charging valves, High pressure switch, High pressure transducers, Low pressure transducers, Oil pressure transducer and Suction temperature sensor.

Electrical panel: Power and control are in the main panel that is manufactured to ensure protection against all weather conditions. It is IP54 and internally protected against possible accidental contact with live parts when the doors are open. The main panel is fitted with interlocked main switch door that interrupts power supply when opening.

Controller: Latest generation MicroTech 4 controller provides an easy to use control environmental. The control logic is designed to provide maximum efficiency, to continue operation in unusual operating conditions and to provide a history of unit operation. Sophisticated software with adaptive logic selects the most energy efficient combination of compressor load, electronic expansion valve position and fans to keep stable operating conditions and maximize chiller efficiency and reliability. One of the greatest benefits is the easy interface with LonWorks, Bacnet, Ethernet TCP/IP or Modbus communications.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Cooling mode performances

Cooling capacity	613.3 kW	Chilled water IN/OUT	12.00 °C / 7.00 °C
Power input	204.3 kW	Chilled water flow	29.25 l/s
EER Cooling Efficiency	3.001 kW / kW	Water heat exchanger pressure drops	45.4 kPa
		Ambient temperature	35.0 °C
		Lw / Lp @ 1m	95 dB(A) / 74 dB(A)
SEER / ηs	4.72 / 185.8%	Fluid	Water
		Water heat exchanger fouling factor	0.000 m2°C/W

SEER declared according to EN14825, fan coil application 12/7°C (inlet/outlet) water temperatures. Sound power level according to ISO 9614-1. SEER and IPLV.IP refer to standard unit without options

Heating mode performances

Heating capacity	504.4 kW	Heated water IN/OUT	37.00 °C / 43.30 °C
Power input	188.0 kW	Heated water flow	19.15 l/s
COP Heating Efficiency	2.682 kW / kW	Water heat exchanger pressure drops	21.0 kPa
SCOP / ηs	3.880 / 152.2%	Ambient temperature	-3.0 °C

SCOP declared according to EN14825, average climate, low temperature application

Unit information

Compressor type	Scroll	Refrigerant type	R32
Capacity control	STEP	Air heat exchanger type	HFP
Compressor N°	6	Air heat exchanger fans N°	14
Circuit N°	2	Air heat exchanger fans control	BRS
Refrigerant charge	158 kg	Altitude	000 MSL
		Water heat exchanger type	Plated Heat Exchanger

Actual refrigerant charge depends on the final unit construction, refer to unit nameplate.

Electrical information

Power supply	400 V / 50.0 Hz / 3 Ph	Max. inrush current	830 A
Running current	346.94 A	Compressor starting method	Direct on line
Max. Running current	497 A		
Max. current wires sizing	546.7 A		

Voltage tolerance ± 10%. Phase Voltage unbalance ± 3%. Electrical data referred to standard unit without options, refer to unit name plate data.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Acoustic information

Sound pressure level at 1 m from the unit (rif. 2 x 10-5 Pa)

63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	db(A)
84.0	78.0	77.0	75.0	70.0	65.0	59.0	59.0	**74.2**

Values referred to Evap. IN/OUT 12/7°C and 35°C Amb., full load operation, standard unit configuration without options. Sound pressure level calculated from sound power level. Sound pressure in octave band is for information only and not considered binding.

Physical information

Evap. connections size	**88.9 mm**	Length	**6825 mm**
		Width	**2282 mm**
Weight shipping/operating	**5020 kg / 5090 kg**	Height	**2514 mm**

Information referred to standard unit configuration without options, refer to certified unit drawing.

EWYT650B-XRA2+OP142C

Performances calculated according to EN14511-3:2013

Certification notes

Within the scope of AHRI Air-Cooled Water-Chilling Packages Certification Program. AHRI Certified performance may be obtained from the manufacturer's representative

General notes

For more information about the above selected product, please go to http://www.daikineurope.com/industrial/. Unit performances are reproducible in laboratory test environment only in accordance to recognized industry standards. This technical data sheet is generated by Daikin Applied Tool software designed and distributed by Daikin Applied Europe S.p.A. The present software does not constitute an offer binding upon Daikin Applied Europe S.p.A who compiled the content of this software to the best of its knowledge. No express or implied warranty is given for the completeness, accuracy, reliability or fitness for particular purpose of its content and the products and services presented therein. Specifications are subject to change without prior notice. Daikin Applied Europe S.p.A. explicitly rejects any liability for any direct or indirect damage, in the broadest sense, arising from or related to the use and/or interpretation of this document. All content is copyrighted by Daikin Applied Europe S.p.A.

EWYT650B-XRA2+ OP142C

> Air to water reversible heat pump
> Scroll compressor
> High efficiency version
> Reduced sound configuration
> R-32 refrigerant

Unit description: Daikin air to water reversible heat pump with hermetic scroll compressors and R32 refrigerant. Unit colour is ivory White (Munsell code 5Y7.5/1) (±RAL7044).

Compressors: Hermetic orbiting scroll designed for R32 operation and complete with motor over-temperature and over-current protection devices. Each compressor is equipped with an oil heater that keeps the oil from being diluted by the refrigerant when the chiller is not running. The compressors are connected in Tandem or Trio configuration on each refrigerant circuit. Each compressor is mounted on rubber antivibration mounts for a quite operation. Unit is delivered with complete oil charge.

Water side Heat Exchanger: The unit is equipped with a direct expansion plate to plate heat exchanger. This heat exchanger is made of stainless-steel brazed plates and covered with a 20mm closed cell insulation material. The exchanger is equipped with an electric heater for protection against freezing. Water connections are provided with Victaulic kit.

Air side Heat Exchanger: The air side heat exchanger is manufactured with internally enhanced seamless copper tubes arranged in a staggered row pattern and mechanically expanded into lanced and rippled aluminum fins with full fin collars. An integral sub-cooler circuit provides sub-cooling to effectively eliminate liquid flashing and increase cooling capacity without increasing the power input.

Air side Heat Exchanger fans: The fans are propeller type with high efficiency design blades to maximize performances. Fan blades are made of glass reinforced resin and each fan is protected by a guard. Parallel Coil units are equipped as standard with fan speed modulation (phase cut). Double V Coil units (standard and low sound versions) are equipped with on/off fans and inverter drive is available as an option. Double V Coil units reduced noise versions are equipped with inverter driven fans as standard.

Refrigerant circuit: Each unit has one or two independent refrigerant circuits and each one includes: Compressors, Refrigerant, Water Side Heat Exchanger, Air Side Heat Exchanger, Electronic expansion valve, 4-way valve, Sight glass with moisture indicator, Filter drier, Charging valves, High pressure switch, High pressure transducers, Low pressure transducers, Oil pressure transducer and Suction temperature sensor.

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		Ambient temperature	35.0 °C
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SEER / ηs	4.72 / 185.8%	Fluid	Water
		Water heat exchanger fouling factor	0.000 m2°C/W

SEER declared according to EN14825, fan coil application 12/7°C (inlet/outlet) water temperatures. Sound power level according to ISO 9614-1. SEER and IPLV.IP refer to standard unit without options

Heating mode performances

Heating capacity	508.9 kW	Heated water IN/OUT	43.30 °C / 50.00 °C
Power input	212.1 kW	Heated water flow	18.17 l/s
COP Heating Efficiency	2.399 kW / kW	Water heat exchanger pressure drops	19.1 kPa
SCOP / ηs	3.880 / 152.2%	Ambient temperature	-3.0 °C

SCOP declared according to EN14825, average climate, low temperature application

Unit information

Compressor type	Scroll	Refrigerant type	R32
Capacity control	STEP	Air heat exchanger type	HFP
Compressor N°	6	Air heat exchanger fans N°	14
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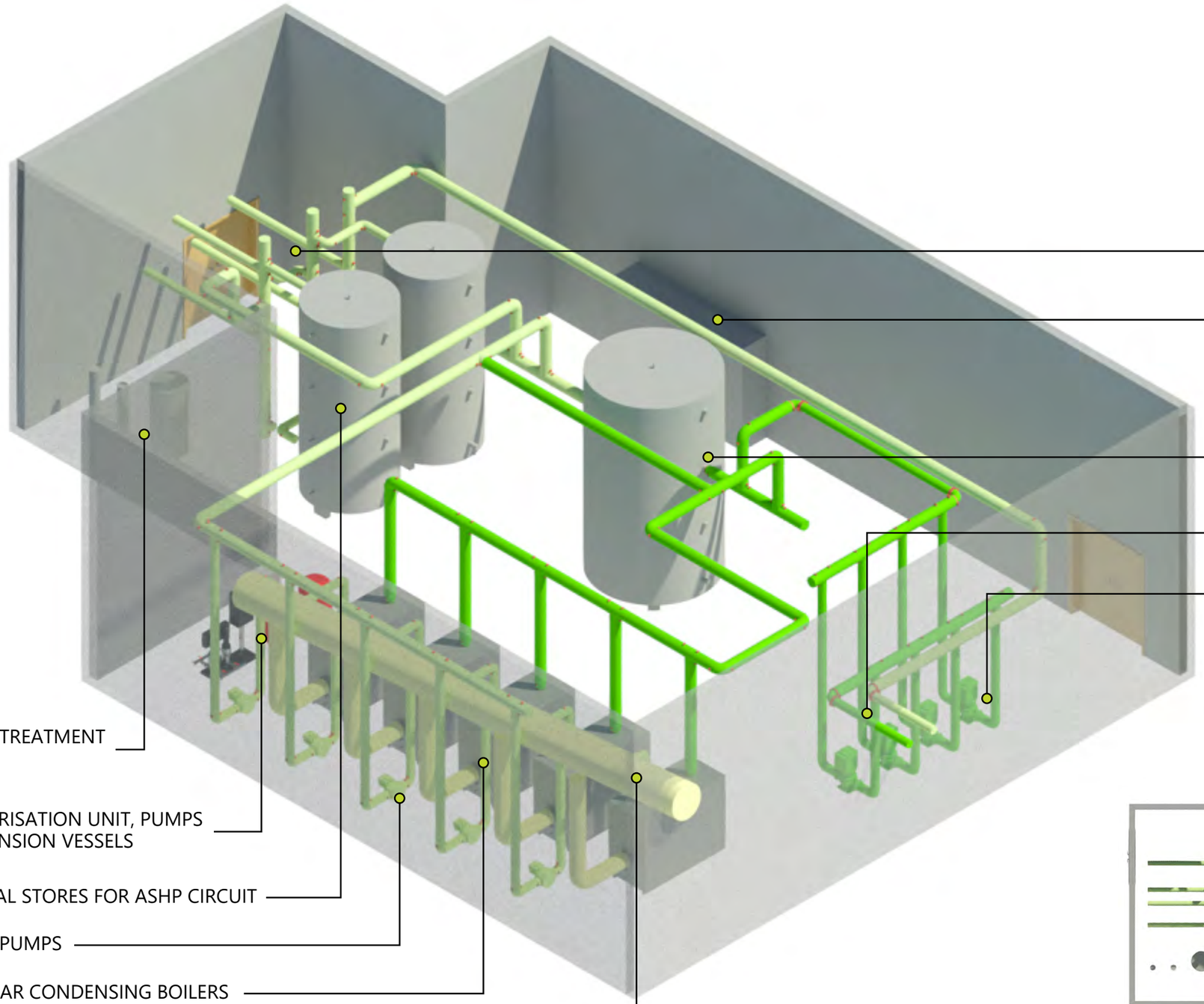
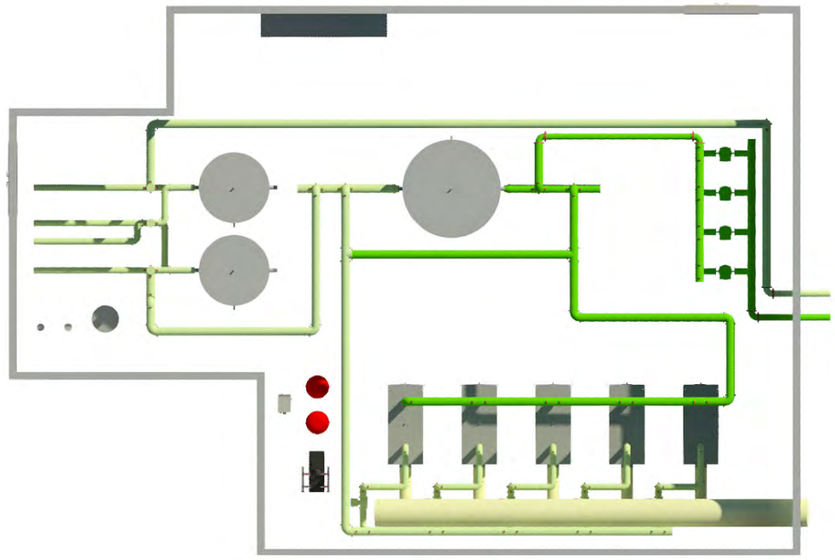
Appendix I

Indicative Energy Centre Plan





TOTAL AREA = 190 m²

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

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Appendix J

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

September 2020

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

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.

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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.

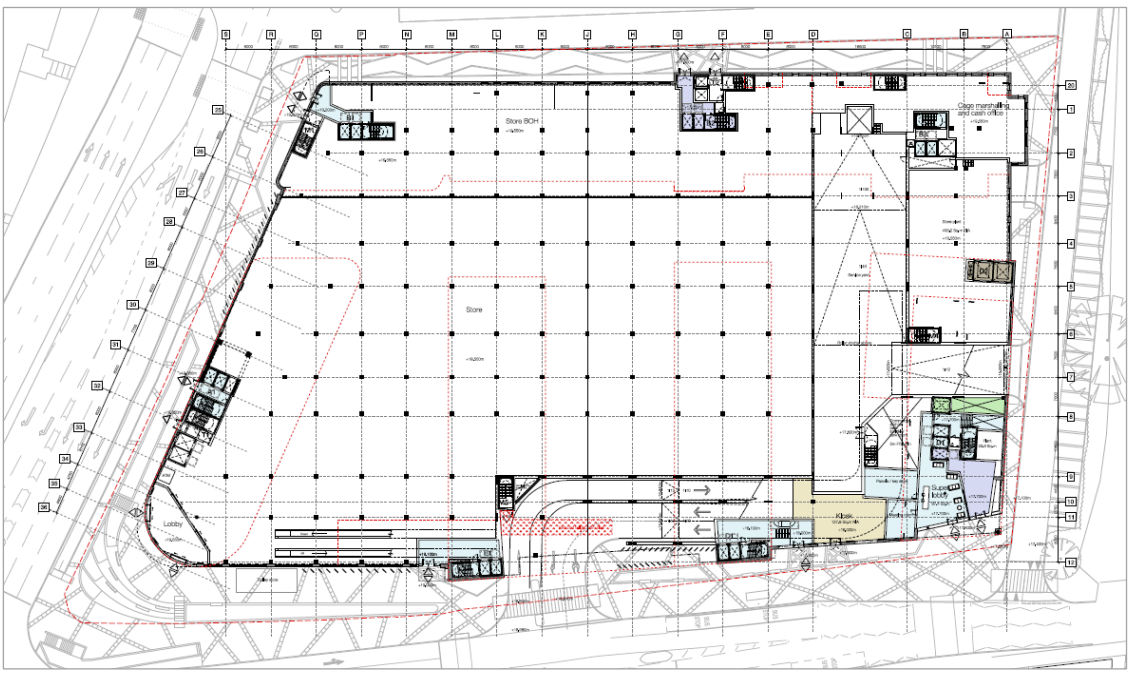

Figure 2: Site layout at ground floor (Patel Taylor, 2020)

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:

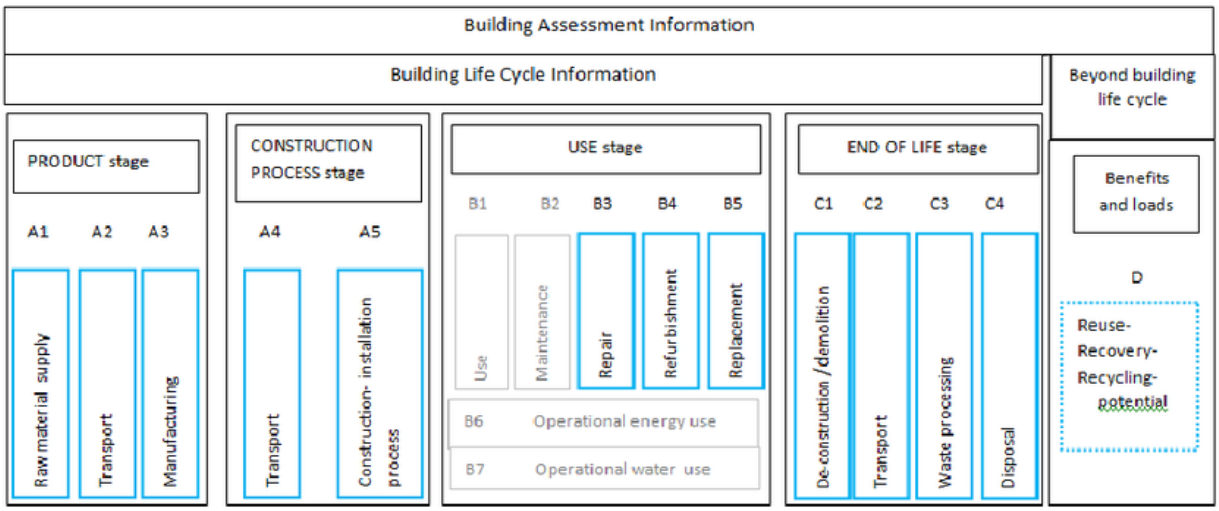

Figure 3: Life Cycle Stages of a Building (Source: BS EN 15978:2012)

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 'Very Good' 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.

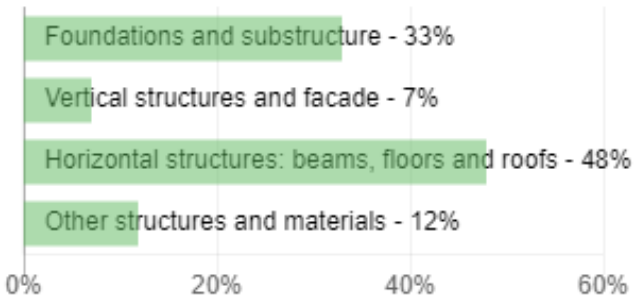

Figure 5: Embodied carbon by structure – A1-A3

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.

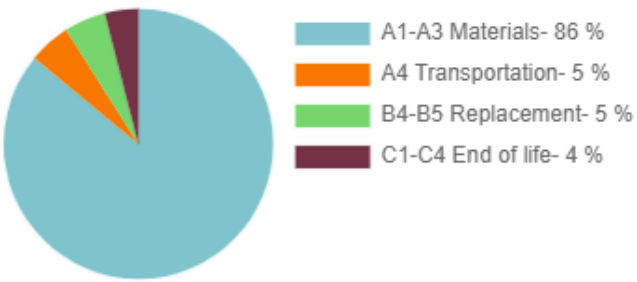

Figure 6: Embodied carbon by life-cycle stage

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 K

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 CO2 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

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