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Energy Statement

Berkeley Homes (Oxford & Chiltern) Ltd.

Kenavon Drive, Reading

Final V6

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Executive Summary

This Energy Statement seeks to amend the consented energy strategy as required under Condition 50 (170509/FUL). The drive for this change is centred on the delivery of a strategy which provides real savings in CO₂ emissions. In this way the energy strategy will be future-proofed. As explained in this report, persistence with the current strategy will lock the development into an increasingly poor environmental performance as the existing SAP 2012 CO₂ emission factors become increasingly outdated.

The overriding objective in the formulation of the strategy is to maximise reductions in CO₂ emissions through the application of this hierarchy with a technically appropriate approach. The proposed strategy will provide the following:

- > High standards of fabric efficiency, going significantly beyond the requirements of Part L 2013. This includes low air permeability rates and targeted thermal bridges;
- > High efficiency air source heat pumps (ASHPs) to the commercial units;
- > MVHR or MEV systems to all dwellings, providing heat recovery & cooling whilst contributing further to the overall CO₂ reduction of the development;
- > Efficient & simple systems for residents to use;
- > High levels of control for resident comfort;
- > Greater tariff flexibility for residents to reduce their heating costs;
- > Application of substantial levels of PV panels to all suitable roof areas, providing significant generating potential for the overall development.

The key element of the new proposal is to supply heat to the development from low carbon electricity, rather than install a gas CHP-led heat network. This delivers much higher CO₂ savings to the development when assessed against the more accurate SAP 10 CO₂ emissions factors, providing day 1 CO₂ savings of approximately 40% which will continue to increase as the electricity grid continues to decarbonise.

Historically, CHP strategies have provided substantial CO₂ reductions. However, due to decarbonisation of the grid, the reductions have now been eliminated and subsequently, this now results in a net increase in Regulated CO₂ emissions. Many of the gas & CHP orientated strategies which have been implemented in the past 10 years would no longer be compliant when assessed against the more representative SAP 10 emission factors.

The proposed energy strategy seeks to prioritise measures which first and foremost reduce energy demand, before assessing means of energy supply and alternative generation sources. This is considered a best practice approach. However, the scheme will also incorporate multiple low and zero carbon technologies to further reduce site wide CO₂ emissions as well as providing a source of on-site electricity generation.

Expected energy demands have been tested against the forward-looking SAP 10 methodology which more accurately reflects the decarbonisation of the electricity grid. CO₂ savings will therefore be delivered in the long-term through a future-proofed energy strategy, as set out in the table below.

In summary, the development is expected to achieve a **26.1%** reduction in Regulated CO₂ emissions. This goes significantly beyond the requirements of current adopted planning policy and condition 49 of the current consent. In contrast, application of the consented energy strategy would result in Regulated CO₂ emissions of **-34.9%** against the calculated baseline.

Full Site – Regulated Carbon dioxide emissions (kg CO ₂ per annum)		
	Proposed Strategy	Consented Strategy
Baseline	774,200	742,300
After <i>Energy Efficiency</i> Measures	678,200	1,001,400
After <i>Renewable</i> Measures	572,300	-
Total % Savings (On-site)	26.1%	-34.9%

CONTENTS

Executive Summary	2
1. INTRODUCTION	5
2. DEVELOPMENT OVERVIEW	6
3. ENERGY STRATEGY METHODOLOGY	8
Baseline Emissions Assessment	9
Report Methodology	10
4. ENERGY EFFICIENCY MEASURES – DEMAND REDUCTION	11
Residential Areas	11
Residential - Fabric Energy Efficiency	14
Commercial Areas	15
CO ₂ Emissions After Demand Reduction Measures	16
5. HEATING STRATEGY	17
Utility Availability – Heat & Electricity	17
Proposed Strategy - Direct Electric Heating	18
6. RENEWABLE ENERGY TECHNOLOGIES	19
7. SUMMARY	21
APPENDICES	23
Appendix A SAP 10 Calculations	23
Appendix B TER Worksheets for Representative Dwellings	23
Appendix C DER Worksheets for Representative Dwellings	23
Appendix D SBEM BRUKL Reports for Representative Non-Residential Spaces (<i>Taken from MLM Energy Statement</i>)	23
Appendix E PV Panels – Indicative Roof Plan	23

1. INTRODUCTION

- 1.1** This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, on behalf of Berkeley Homes (Oxford & Chiltern) Ltd in support of the consented development of the Kenavon Drive site in Reading.
- 1.2** This Energy Statement has been prepared to vary Condition 50 of the planning consent (Ref. 170509/FUL). The variation is necessary to ensure that the development's energy strategy is fit for the future and is not reliant on technologies that have historically provided good carbon performance, but which have ceased to do so due to the rapid decarbonisation of the national electricity grid, which have not yet been accounted for within the regulatory compliance mechanism. This document will demonstrate that the proposed alteration represents a significant enhancement in the real carbon performance of the development.
- 1.3** The formulation of the energy strategy follows a review of the approved energy strategy pursuant to planning permission 170509/FUL and considers several important concerns and priorities. These include:
- > To achieve the maximum reduction in carbon dioxide (CO₂) emissions by considering future trends for energy supply and generation as well as current ones;
 - > To determine an energy strategy which is deliverable, technically appropriate and which does not result in unreasonable running costs for occupants;
 - > The provision of high-quality low energy buildings that are adapted to future changes in climate;
 - > To minimise, to the lowest possible extent, emissions of pollutants such as oxides of nitrogen (NO_x) and particulate matter, thereby minimising the effects on local air quality.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 The Kenavon Drive development is located in the centre of Reading, 0.5km east from the rail station.

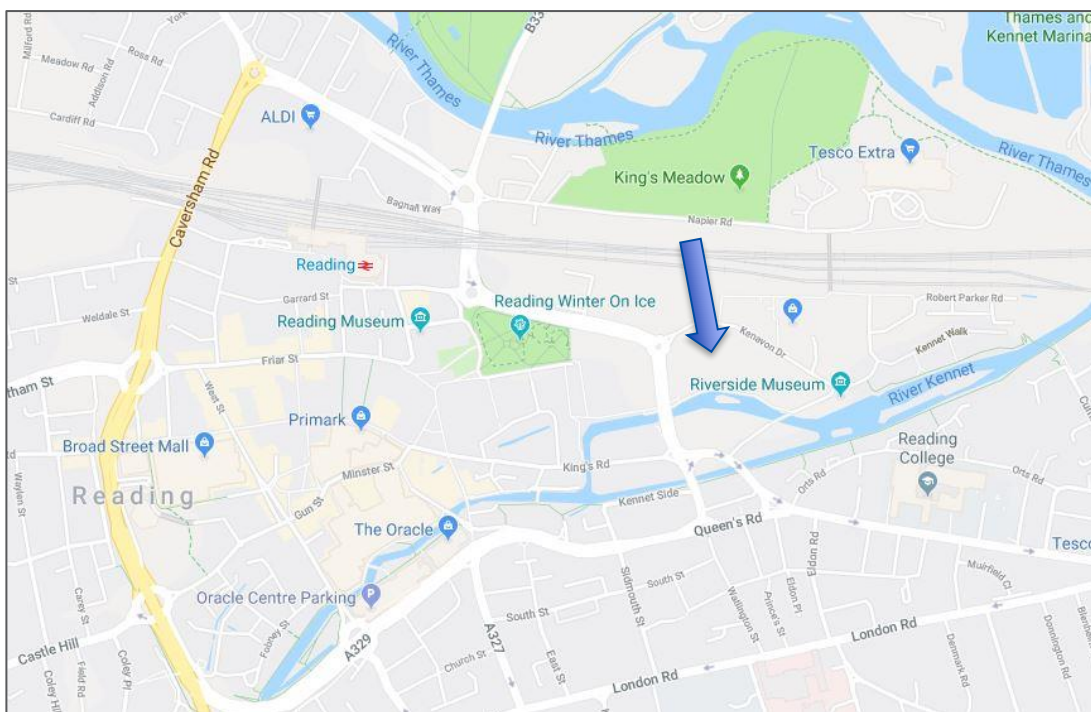


Figure 1: Site Location (Source: Imagery @ 2019 Google, Map data ©2019 Google)

Consented Energy Strategy Performance

2.2 Planning permission was granted on the site in October 2018 (Ref: 170509/FUL) for the delivery of 765 dwellings and 5 commercial units.

2.3 Planning condition 49 states:

'No dwelling within the relevant phase of development (a) phase 1, b) phase 2, c) phase 3, as per Indicative Phasing Plan AA5990-2010 Rev A, as received 03/10/2017 hereby permitted shall be first occupied until written documentary evidence has been submitted to, and approved in writing by, the local planning authority demonstrating that 50% of the dwellings hereby permitted have achieved a minimum of 19% improvement in the dwelling emission rate over the target emission rate, as defined in The Building Regulations for England Approved Documents L1a: Conservation of Fuel and Power in

New Dwellings (2013 edition). Such evidence shall be in the form of an As Built Standard Assessment Procedure, produced by an accredited energy assessor.'

2.4 Planning condition 50 states:

"The development will be carried out in accordance with the energy measures hereby approved in the Energy Statement by MLM Consulting Engineers Ref GH/714777/CKN Rev 06 dated 21/03/17, as received 19/03/17."

- 2.5** The MLM Energy Statement provided a heating strategy based on a communal heat network led by gas Combined Heat & Power (CHP). Historically CHP strategies have provided substantial CO₂ reductions. However, the decarbonisation of the electricity grid has eliminated these. SAP10 provides emission factors that represent current reality. Based on these up-to-date figures, the performance of a CHP-led strategy is presented below in Table 1.

Consented Strategy – Regulated Carbon dioxide emissions (kg CO₂ per annum)		
	SAP 2012 Emission Factors	SAP 10 Emission Factors
Baseline (Target Emissions Rate)	878,500	742,300
Consented Strategy	600,600	1,001,400
CO₂ Reduction (%)	31.6%	-34.9%

Table 1: Consented Strategy

- 2.6** It is evident from Table 1 that CHP-led strategies now *increase*, as opposed to decrease, CO₂ emissions. For a developer aspiring to provide an environmentally friendly development that people aspire to live in, it is important that the energy strategy is revised to achieve this and deliver immediate and sustained reductions in carbon emissions.
- 2.7** The MLM energy statement also provided the following, which are not altered by this alternative energy strategy:
- > Centralised mechanical extract (MEV) or mechanical ventilation with heat recovery (MVHR) ventilation systems to all dwellings;
 - > High levels of building fabric design, including U-values that go significantly beyond the minimum requirements of Part L of the Building Regulations and targeted psi values to alleviate thermal bridging;
 - > An air tightness target of 5m³/h.m²;
 - > Air source heat pumps (ASHPs) to the commercial units to provide space heating and cooling;
- 2.8** A 19% reduction in Regulated CO₂ emissions was targeted in the MLM strategy. This will still be achieved with the proposed energy strategy outlined in this report.

3. ENERGY STRATEGY METHODOLOGY

- 3.1** The approach taken for the development of the energy strategy is to reflect current reality and future projections for carbon emissions as opposed to the historical situation. In so doing, the carbon reductions shown can be expected to continue through the lifespan of the development.
- 3.2** The CO₂ emission factors in current Part L (2013) & SAP 2012 are outdated. This is shown in Figure 2, below.

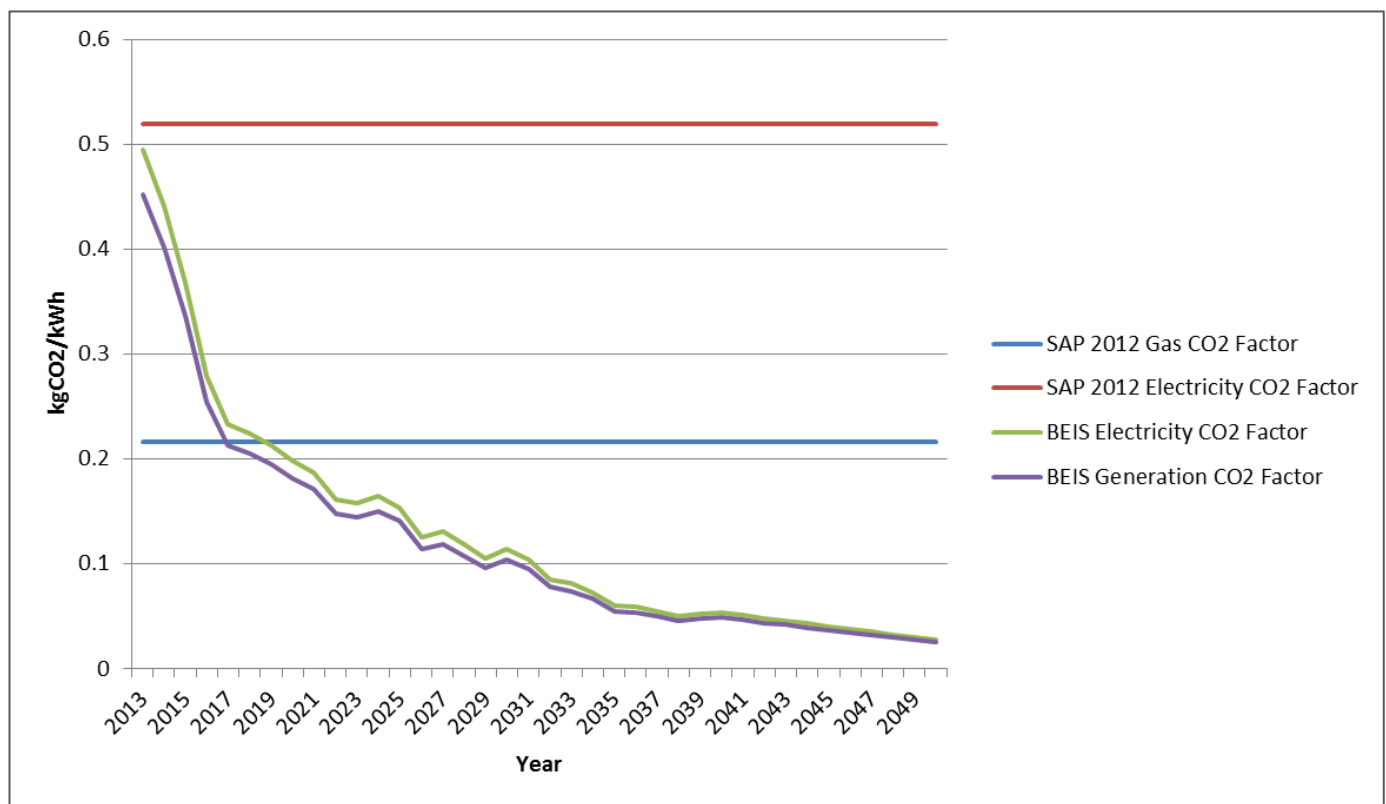


Figure 2: SAP 2012 and BEIS Projected Emission Factors (2013 – 2050)

- 3.3** SAP 2012 & Part L 2013 therefore fail to take account of current actual CO₂ emission factors. The actual electricity emission factor has declined substantially since 2012 due to the increased amount of renewable electricity generation and declining use of coal generation.
- 3.4** As Part L is expected to not be updated until 2022 the current emission factors used for compliance by this stage will be 10 years out of date. Unrealistic emission factors could lead to inappropriate energy strategies which are not future proofed. For example:

- > Gas CHP strategies would not pass the minimum requirements of Part L of the Building Regulations when using the SAP10 factors, as shown in Table 1. This is because gas CHP engines will increase rather than decrease CO₂ emissions under real current emission factors. A gas CHP strategy would not therefore enable compliance with the local planning energy targets.

- 3.5 Alternative approaches are therefore desirable in determining the most appropriate energy strategy for a development in the context of the aims set out in the introduction.
- 3.6 SAP10 has been developed by BRE and is intended for use with the next update of Part L. It therefore gives foresight regarding the trajectory of CO₂ emission factors.
- 3.7 The proposed changes to these are summarised in Table 2.

	SAP 2012	SAP 10	Change
Gas Emission factor (kg CO ₂ /kWh)	0.216	0.210	3% reduction
Electricity Emission factor (kg CO ₂ /kWh)	0.519	0.233	55% reduction

Table 2: SAP 10 summary of emission factor changes

- 3.8 It is important to note that at present any assessment would be required to use SAP 2012 and therefore compliance with Part L 2013 should still be achieved. Any site-based carbon emissions would have to be converted using SAP 10 figures (as per the GLA's carbon emissions conversion tables) to identify the equivalent site wide emissions under the proposed methodology.

Assessment Methodology

- 3.9 Due to the above, we have concluded that it is most appropriate to utilise SAP10 emission factors in the development of this energy strategy.
- 3.10 This approach is supported by the Greater London Authority (GLA), who now encourage the use of SAP10 factors at planning stage ahead of the new Part L being in place. This is outlined in their 'Energy Assessment Guidance, 2018'.

Baseline Emissions Assessment

- 3.11 Table 2 shows the Regulated baseline CO₂ emissions for both the residential and commercial aspects. As outlined above, emissions have been calculated against the SAP 10 emission factors as these are considered more appropriate.

Table 3: Regulated Baseline Case – SAP 10 Emission Factors	
	Regulated CO₂ (kg/year)
Residential	703,500
Commercial	70,700

Table 3: SAP 10 Baseline Emissions

Report Methodology

- 3.12** Following the establishment of an emission baseline to assess against, the report will now follow a ‘fabric first’ approach in order to prioritise measures which reduce energy demand before assessing energy supply and generation measures.
- 3.13** The estimated annual energy demand for the residential portion of the Kenavon Drive development has been calculated using Standard Assessment Procedure (SAP 2012) methodology, with energy (kWh/yr) outputs from the TER and DER worksheets used to apply the SAP10 emission factors. SAP calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items.
- 3.14** Calculations have been performed on representative dwelling types. These encompass mid and top floor flats, as well as taking into account differences in orientation and the impact of exposed floors and terraces. The selected dwellings therefore represent a fair aggregation of the proposed unit mix.
- 3.15** The estimated annual energy demand for the proposed commercial units has been calculated using Simplified Building Energy Model (SBEM 2013) methodology. SBEM calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items. Similarly, outputs have been updated in line with the SAP 10 emissions factors.

4. ENERGY EFFICIENCY MEASURES – DEMAND REDUCTION

- 4.1** In line with a fabric first approach which seeks to minimise energy demand, the following energy efficiency measures are proposed for all dwellings.

Residential Areas

Insulation Standards

- 4.2** The residential units will incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-Values over and above those required by Part L (2013) Building Regulations. These are likely to include:
- > Glazing with a U-value of 1.40 W/m².K;
 - > External wall U-value of 0.17 W/m².K;
 - > Party walls will be fully insulated and sealed (achieving an effective U-Value of 0.00 W/m².K);
 - > Corridor wall with a U-value of 0.17 W/m².K;
 - > Exposed upper floor U-values (over plant rooms, car parks, and commercial areas) of 0.15 W/m².K;
 - > Ground floor U-values of 0.10 W/m².K;
 - > A main roof U-value with a U-value of 0.11 W/m².K.

Air Tightness & Ventilation

- 4.3** Air tightness standards will conform to, and exceed, Approved Document Part L requirements. By reducing air leakage loss and convective bypass of insulation, an improvement of design air permeability rate from 10m³/h.m² to 5m³/h.m² or less will further reduce space heating requirements.
- 4.4** It is proposed to install Parts L & F compliant (System 3) Centralised Mechanical Extract Ventilation (MEV) and Mechanical Ventilation with Heat Recovery (MVHR) to all units.
- 4.5** These systems will remove stale air and odours from kitchens and wet rooms. The selected systems will prioritise efficiency and performance to contribute towards the overall CO₂ emissions reduction

for the development, as well as facilitating internal cooling without the use of additional mechanical cooling measures.

4.6 Where MVHR is utilised, the highly efficient heat recovery function with further assist in reducing space heating demands, maximising CO₂ reductions.

4.7 The selected MEV units will have a Specific Fan Power (SFP) targeted as follows:

> ≤ 0.19 SFP for units with 2 wet rooms (1 bathroom);

> ≤ 0.20 SFP for units with 3 wet rooms (2 bathrooms).

4.8 The selected MVHR units will have heat recovery efficiencies of 94% and a Specific Fan Power (SFP) targeted as follows:

> ≤ 0.40 SFP for units with 2 wet rooms (1 bathroom);

> ≤ 0.43 SFP for units with 3 wet rooms (2 bathrooms).

Thermal Bridging

4.9 In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g. metal studs) in the wall construction enable a low resistance escape route for heat. As energy efficiency standards improve, an increased importance is being placed on addressing heat losses through thermal bridging.

4.10 Figure 3 illustrates the benefits of reducing thermal bridges.

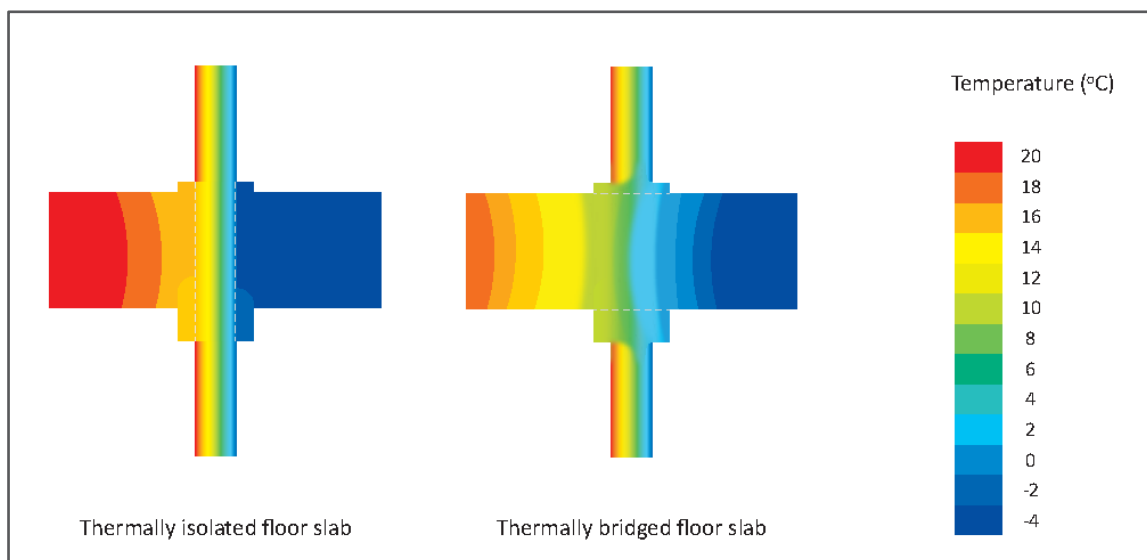


Figure 3: Thermal Bridging

- 4.11** The Applicant is likely to undertake detailed modelling of all major junctions. The results of initial assessments will be used to inform the design process and further modelling will continue to take place until the required performance targets are met. It should be noted that this bespoke approach to junction design goes significantly beyond the process followed for most developments, thus achieving an improved energy performance.
- 4.12** It is also considered that a specification which actively seeks to design out poor junction performance demonstrates a more balanced approach than only the use of very low U-values which have been specified to mitigate a lack of junction modelling. The specification for the proposed Kenavon Drive development places significant emphasis on both design aspects.
- 4.13** The following psi values have been used in the initial modelling and will be targeted during the detailed design:
- > Exposed Floors (over car parks, plant rooms, commercial areas) – 0.20 W/m.K;
 - > Intermediate Floor – 0.07 W/m.K;
 - > Balcony junction to wall – 0.15 W/m.K;
 - > Flat roof – 0.04 W/m.K;
 - > Flat roof with parapet – 0.30 W/m.K;
 - > Party Roof – 0.04 W/m.K;
 - > Corner (normal) – 0.12 W/m.K;
- 4.14** Further details will be determined during the detailed design stage when further bespoke calculations are undertaken on the targeted junctions.
- 4.15** Values equivalent to the Accredited Construction Details (ACDs) have also been used for the Lintels (0.30W/m.K), Sills (0.04W/m.K), and Jambs (0.05W/m.K) of the windows. It is not considered appropriate to target higher performance standards than this at this point due to the impact that the choice of glazing manufacturer may have on the detailing.

Space Heating & Hot Water

- 4.16** The space heating requirement of the proposed Kenavon Drive development will be reduced by the fabric, air tightness and ventilation measures detailed above.
- 4.17** The houses and duplex units could be heated from highly efficient air source heat pumps (ASHPs). These will significantly lower the CO₂ emissions of the development if utilised.

- 4.18** It is proposed that all flats are heated from electric resistance heaters, with hot water provided from insulated cylinders in each dwelling. The Applicant has sought to utilise electricity to heat the dwellings as a result of the continuing decarbonisation of the electricity grid. This is further explored in Section 6 of this report.
- 4.19** To provide incentives for the residents to minimise their energy use, charging for heat will be linked to use, rather than only a standing charge.

Limiting the Risk of Summer Overheating

- 4.20** Minimising the risk of summer overheating is important so as to ensure that homes are adapted to climate change and remain comfortable to occupy in the future.
- 4.21** The key measures identified in order to mitigate overheating risk are as follows:
- > Shading is provided to a significant proportion of the windows from the presence of balconies. The balconies will provide solar shading during the summer months when the sun is high in the sky, but allow the beneficial winter solar gains when the sun is lower in the sky;
 - > Solar control glazing (low g-value) will be installed to reduce uncomfortable solar heat gains across the development. A g-value of 0.45 has been used in the compilation of this energy strategy;
 - > All homes will have openable windows and therefore the ability to naturally ventilate.
- 4.22** The overheating strategy does not utilise active cooling measures. This ensures an additional energy demand is not added to the development to facilitate cooling.

Lighting & Appliances

- 4.23** Energy efficient lighting will be installed in 100% of internal fittings in the homes.
- 4.24** It is very difficult to design and construct homes to reduce the unregulated electricity demands, because this is almost 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.

Residential - Fabric Energy Efficiency

- 4.25** The measures outlined in Section 5 enable the development to exceed the Target Fabric Energy Efficiency (TFEE) requirements of Building Regulations Part L1A (2013), as shown in Table 4 below.

Residential - Example Unit Type	Unit Area (m ²)	No. Units	TFEE (kWh/m ² /yr)	DFEE (kWh/m ² /yr)
1B Mid Floor Mid-Terrace – SE Orientation	48	210	44.2	41.4
1B Mid Floor Mid-Terrace – NW Orientation	48	210	35.6	36.8
2B Exposed Floor – NW Orientation	63	75	59.9	53.4
2B Mid Floor End-Terrace – NW/SW Orientation	63	135	40.1	43.3
2B Top Floor End-Terrace – SE/SW Orientation	63	90	54.7	49.3
3B Top Floor End-Terrace – SE/SW Orientation	84	45	57	48.3
Area Weighted Average			45.6	43.7
Reduction Achieved (Area Weighted)			4.2%	

Table 4: TFEE/DFEE results for sample dwelling types

Commercial Areas

- 4.26** The same principles adhered to for the residential areas, of prioritising measures which reduce energy demand, will also be followed for the commercial areas.
- 4.27** It should be noted that the Applicant will not be responsible for fitting out the commercial areas and will therefore be delivering shell space with service connections for the tenants to take on.

Insulation Standards

- 4.28** The commercial areas will similarly incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-Values better than those required by Part L (2013) Building Regulations. These are likely to include:
- > Glazing with a U-value of 1.6 W/m².K;
 - > External wall U-value of 0.20 W/m².K;
 - > Sheltered wall U-value of 0.20 W/m².K;
 - > Ground floor U-values of 0.10 W/m².K;
 - > Roof U-values of 0.13 W/m².K.

Ventilation & Air Permeability

- 4.29** It is assumed that intermittent extract fans will be utilised in bathrooms and kitchenettes where provided.

4.30 Air leakage is to be minimised and an air permeability of below 7.0m³/hr/m² will be targeted.

Limiting the Risk of Summer Overheating

4.31 Solar control glazing will be specified throughout the commercial areas to mitigate overheating risk. The solar gain limit has not been exceeded in any of the BRUKL assessments undertaken.

Lighting

4.32 One of the major energy demands within the commercial spaces is likely to be lighting. Energy efficient LED light fittings are to be specified for all commercial areas.

4.33 The lighting for the cafés/restaurant and retail areas has been modelled at 90 lamp lumens per circuit watt. The nursery has been modelled 90 luminaire lumens per circuit watt.

4.34 Zoning of lighting circuit controls will allow for greater benefit to be made of natural daylight in the areas where it is available, without compromising light levels further away from windows.

Heating and Cooling

4.35 Space heating and cooling will be provided to all commercial units from heat pumps. Hot water will be provided by electric point of use heaters for each unit.

CO₂ Emissions After Demand Reduction Measures

4.36 Tables 5 and 6, below, show the CO₂ savings for both the residential and commercial elements following the aforementioned demand reduction measures.

Residential (kg CO ₂ per annum)	
	Regulated Emissions
Baseline	703,500
After <i>Energy Efficiency Measures</i>	612,000
Total % Savings (On-site)	13.0%

Table 5: Residential Demand Reduction CO₂

Commercial (kg CO ₂ per annum)	
	Regulated Emissions
Baseline	70,700
After <i>Energy Efficiency Measures</i>	66,100
Total % Savings (On-site)	6.5%

Table 6: Commercial Demand Reduction CO₂

5. HEATING STRATEGY

- 5.1** As outlined in Section 2 of this report, the use of SAP 10 emissions factors shows the consented energy strategy with gas CHP to no longer deliver CO₂ savings. As SAP 10 emission factors are a much more accurate reflection of the current and future projected carbon intensity of mains electricity generation, it is more appropriate to assess the energy strategy for the Kenavon Drive development against this metric.
- 5.2** When considering the long-term CO₂ performance of the energy strategy for this development, the options for the supply of heat to the site can be summarised as follows:
- > Decentralised energy network with a heat source which is not gas-fired;
 - > Direct electric systems to each flat.
- 5.3** It should be noted that the commercial units will remain as per the consented energy strategy, which utilises ASHPs for the supply of space heating and cooling, with hot water supplied from a separate individual system specified to the needs of the unit use.

Utility Availability – Heat & Electricity

- 5.4** The connection of the development to an area-wide heat network in central Reading would provide a resilient supply of low carbon heat. However, it is understood that there are no such existing or imminently planned networks, and whilst ambitions to move toward this direction may be present, the absence of clear plans detailing when or where such a network may be delivered renders the risk that the Kenavon Drive development will remain on a site only heating strategy for a very long period too high.
- 5.5** Without connection to an area wide low carbon heat network, the site would need to include an on-site Energy Centre for the generation of heat. No on-site generation source would provide CO₂ reductions equivalent to those offered by an area heat network fed from waste heat sources. For instance heat pump systems, although lower in CO₂ than gas CHP, would still encounter difficulties with ensuring efficiencies were not low and distribution losses were not high.
- 5.6** Whilst a supply of low carbon heat is not available to the site, low carbon electricity is. This enables CO₂ reductions to be locked into the energy strategy from day 1, with no risk that any site heat network may never connect to a wider area one and therefore lock in higher CO₂ emissions for the duration of the development.

Proposed Strategy - Direct Electric Heating

- 5.7 Initial calculations indicate that an electric heating strategy will provide reduced carbon emissions compared to the gas-CHP strategy currently proposed due to grid electricity decarbonisation. This trend is likely to continue as the grid decarbonises further, as indicated in the Figure 4, below.

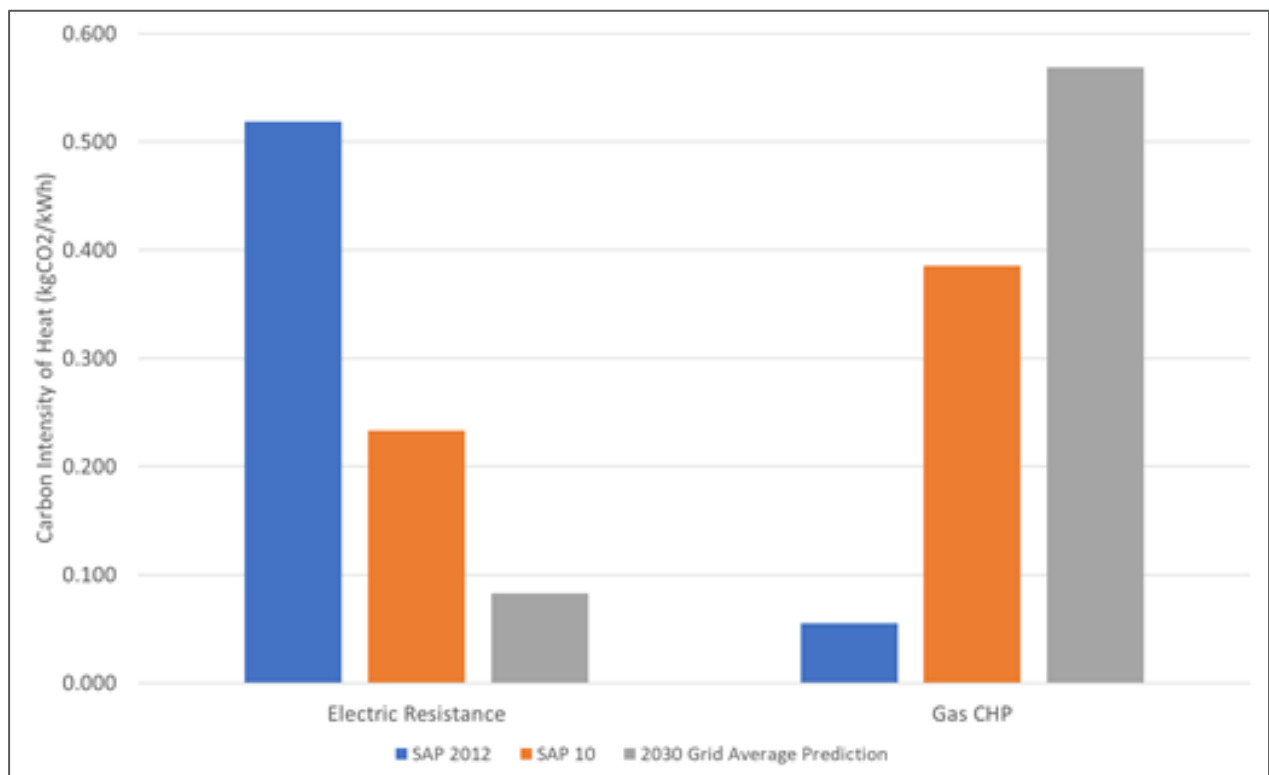


Figure 4: Future Carbon Reductions

- 5.8 It is estimated that a shift to an electric resistance heating strategy will result in Day 1 carbon savings of approximately 40% when compared to the current energy strategy, with additional savings achieved with grid carbon intensity predicted to fall by 84% by 2030 against the Part L 2013 figures on which the current energy strategy is based.
- 5.9 An electric heating strategy will also eliminate distribution losses, which are a significant challenge with current heat networks.
- 5.10 Finally, the move away from the complexity of a site-wide heat network will result in significantly lower costs for capital replacement, maintenance, management, metering and billing of the network. In addition, the high standards of energy efficiency proposed will keep variable costs for heat low.

- 5.11** It is understood that there is sufficient capacity in the local electricity infrastructure to address this electrical demand. The site will also benefit from a substantial capacity of PV generation, which could be used to assist reduce the load on the local electricity network.
- 5.12** If houses and duplex units look to install highly efficient dwelling-level air source heat pumps, this will assist in reducing the site electrical load.
- 5.13** It is therefore proposed that the Kenavon Drive development incorporates electric heating, via room heaters and an immersion cylinder, to each flat. This is to ensure long-term CO₂ reductions, operational reliability, and cost predictability.

6. RENEWABLE ENERGY TECHNOLOGIES

- 6.1** As shown in Tables 4 and 5, an array of energy efficiency measures and a forward-thinking strategy which utilises the ongoing decarbonisation of the electricity network enables the development to achieve a 13.1% and 6.5% reduction in Regulated CO₂ emissions for the residential and commercial elements respectively.
- 6.2** The final part of the energy hierarchy seeks to assess the application of renewable energy technologies to the development. As outlined in the Executive Summary, both air source heat pumps and PV panels are proposed.

Air & Ground Source Heat Pumps (ASHPs & GSHPs)

- 6.3** ASHPs generate heat via compression of a refrigerant which has extracted ambient heat from the external air. The compressive action raises the temperature of the refrigerant and allows it to provide heating.
- 6.4** GSHPs perform a similar action, taking stored heat from the ground instead of the external air. On concentrated development sites such as this, GSHPs are likely to require expensive boreholes to be dug.
- 6.5** ASHPs have been assumed to provide space heating and cooling to all commercial units. A COP of 4.0 for heating and 3.6 for cooling has been proposed.
- 6.6** The houses and duplex units could look to also use ASHPs for heating needs. If proceeding on this route, the Applicant will look to install highly efficient models which will provide significant CO₂ reductions.

Photovoltaic (PV) Panels

- 6.7** PV panels are good at enabling substantial reductions in CO₂ emissions. Additionally, as an energy strategy which utilises electricity for space heating and hot water purposes will increase the load on the local electricity grid, it would be beneficial to have a means of reducing this load through an on-site supply. It has therefore been concluded that PV panels represent the most suitable renewable energy technology for the development.
- 6.8** The Applicant is committed to installing PV panels across the site and as such as set aside substantial areas of roofspace across all blocks. A total of 7,750m² has been made available, which could enable the installation of ~543kWp of PV generating capacity when using a panel output of 280Wp. Panels are to be positioned at an angle of 5-10 degrees towards a southerly direction. An indicative roof plan has been provided in Appendix F.
- 6.9** Tables 7 and 8, below, details the Regulated CO₂ emissions for the development after the addition of the aforementioned measures.

Residential (kg CO ₂ per annum)	
	Regulated Emissions
Baseline	703,500
After <i>Energy Efficiency Measures</i>	612,000
After <i>Renewable Measures</i>	515,900
Total % Savings (On-site)	26.7%

Table 7: Residential Renewable Reduction CO₂

Commercial (kg CO ₂ per annum)	
	Regulated Emissions
Baseline	70,700
After <i>Energy Efficiency Measures</i>	66,100
After <i>Renewable Measures</i>	56,400
Total % Savings (On-site)	20.2%

Table 8: Commercial Renewable Reduction CO₂

7. SUMMARY

- 7.1** This Energy Statement seeks to amend the consented energy strategy as required under Condition 50 (170509/FUL). The drive for this change is centred on the delivery of a strategy which provides real savings in CO₂ emissions. In this way the energy strategy will be future-proofed. As explained in this report, persistence with the current strategy will lock the development into an increasingly poor environmental performance as the existing SAP 2012 CO₂ emission factors become increasingly outdated.
- 7.2** The overriding objective in the formulation of the strategy is to maximise reductions in CO₂ emissions through the application of this hierarchy with a technically appropriate approach. The proposed strategy will provide the following:
- > High standards of fabric efficiency, going significantly beyond the requirements of Part L 2013. This includes low air permeability rates and targeted thermal bridges;
 - > High efficiency air source heat pumps (ASHPs) the commercial units;
 - > MVHR or MEV systems to all dwellings, providing heat recovery & cooling whilst contributing further to the overall CO₂ reduction of the development;
 - > Efficient & simple systems for residents to use;
 - > High levels of control for resident comfort;
 - > Greater tariff flexibility for residents to reduce their heating costs;
 - > Application of substantial levels of PV panels to all suitable roof areas, providing significant generating potential for the overall development.
- 7.3** The key element of the new proposal is to supply heat to the development from low carbon electricity, rather than install a gas CHP-led heat network. This delivers much higher CO₂ savings to the development when assessing against the more accurate SAP 10 CO₂ emissions factors, providing day 1 CO₂ savings of approximately 40% which will continue to increase as the electricity grid continues to decarbonise.
- 7.4** Historically, CHP strategies have provided substantial CO₂ reductions. However, due to decarbonisation of the grid, the reductions have now been eliminated and subsequently, this now results in a net increase in Regulated CO₂ emissions. Many of the gas & CHP orientated strategies which have been implemented in the past 10 years would no longer be compliant when assessed against the more representative SAP 10 emission factors.

- 7.5** The proposed energy strategy seeks to prioritise measures which first and foremost reduce energy demand, before assessing means of energy supply and alternative generation sources. This is considered a best practice approach. However, as noted under point 7.2, the scheme will also incorporate multiple low and zero carbon technologies to further reduce site wide CO₂ emissions as well as providing a source of on-site electricity generation.
- 7.6** Expected energy demands have been tested against the forward-looking SAP 10 methodology which more accurately reflects the decarbonisation of the electricity grid. CO₂ savings will therefore be delivered in the long-term through a future-proofed energy strategy, as set out in the table below.
- 7.7** In summary, the development is expected to achieve a **26.1%** reduction in Regulated CO₂ emissions. This goes significantly beyond the requirements of current adopted planning policy and condition 49 of the current consent. In contrast, application of the consented energy strategy would result in Regulated CO₂ emissions of **-34.9%** against the calculated baseline.

Full Site – Regulated Carbon dioxide emissions (kg CO₂ per annum)		
	Proposed Strategy	Consented Strategy
Baseline	774,200	742,300
After Energy Efficiency Measures	678,200	1,001,400
After Renewable Measures	572,300	-
Total % Savings (On-site)	26.1%	-34.9%

APPENDICES

Appendix A

SAP 10 Calculations

Appendix B

TER Worksheets for Representative Dwellings

Appendix C

DER Worksheets for Representative Dwellings

Appendix D

SBEM BRUKL Reports for Representative Non-Residential Spaces (*Taken from MLM Energy Statement*)

Appendix E

PV Panels – Indicative Roof Plan

Appendix A

SAP 10 and SAP 2012 Calculations

Appendix A - SAP 10 Calculations

SAP/SBEM Outputs per Dwelling/Commercial Type - SAP 10 Emission Factors

Description	Orientation	Energy (kWh/yr)				Energy (kWh/m ² /yr)		Regulated CO ₂ (kg/m ² /yr)		Total CO ₂ (kg/m ² /yr)	
		Space Heating	Hot Water	Regulated Electrical	Unregulated Appliances & Cooking	TFEE	DFEE	TER	DER/BER	TER	DER/BER
1B MF Mid-terrace	SE	1,532	1,411	265	1,211	44.2	41.4	16.86	15.43	29.84	28.40
1B MF Mid-terrace	NW	961	1,411	305	1,211	35.6	36.8	15.32	12.88	28.29	25.85
2B Exp Mid-terrace	NW	3,620	1,820	340	1,584	59.9	53.4	18.46	11.46	31.43	24.44
2B MF End-Terrace	NW/SW	2,100	1,572	340	1,584	40.1	43.3	14.73	14.75	27.71	27.73
2B TF End-Terrace	SE/SW	2,452	1,572	340	1,584	54.7	49.3	17.47	16.05	30.44	29.02
3B TF End-Terrace	SE/SW	2,700	1,742	506	2,095	57	48.3	16.64	13.76	29.62	26.74
Café/Rest - East block		20	140	73	140			65.27	64.12	97.94	96.78
Café - West block		19	140	74	140			65.13	63.92	97.78	96.57
Café/Rest - Middle block		15	133	70	133			61.22	57.39	92.24	88.41
Nursey - Middle block		3	13	13	13			8.92	8.73	11.88	11.70
Retail - West Block		3	2	50	2			18.56	14.49	18.95	14.88

Energy Demands & CO₂ Emissions - Kenavon Drive SAP 10 Emission Factors

Energy Demands & CO ₂ Emissions - Renovation Drive SAH - 10 Emission Factors							Energy (kWh/yr)		Regulated CO ₂ (kg/yr)		Total CO ₂ (kg/m2/yr)	
Description	Unit Area (m2)	No. Units	Energy (kWh/yr)				TFEE	DFEE	TER	DER/BER	TER	DER/BER
			Space Heating	Hot Water	Regulated Electrical	Unregulated Appliances & Cooking						
1B MF Mid-terrace	48	210	321,758	296,323	55,627	254,363	449,713	421,224	171,571	156,974	303,585	288,988
1B MF Mid-terrace	48	210	201,842	296,323	64,107	254,363	362,212	374,422	155,836	131,009	287,850	263,023
2B Exp Mid-terrace	63	75	271,536	136,493	25,482	118,800	284,645	253,757	87,713	54,475	149,370	116,132
2B MF End-Terrace	63	135	283,526	212,201	45,868	213,840	342,999	370,371	126,022	126,191	237,005	237,174
2B TF End-Terrace	63	90	220,639	141,467	30,578	142,560	311,921	281,128	99,594	91,495	173,582	165,484
3B TF End-Terrace	84	45	121,521	78,401	22,771	94,264	214,921	182,118	62,747	51,888	111,670	100,811
TOTAL (Residential)			1,299,300	1,082,807	221,662	983,925	1,966,412	1,883,019	703,482	612,032	1,263,062	1,171,612
Area Weighted Average (/m2)							45.6	43.7	16.3	14.2	29.3	27.2
Improvement over Target							4.2%		13.0%		7.2%	
Café/Rest - East block	157	1	3,086	21,996	11,516	21,996			10,241	10,060	15,366	15,185
Café - West block	156	1	3,028	21,918	11,541	21,918			10,186	9,997	15,293	15,104
Café/Rest - Middle block	658	1	9,722	87,579	45,809	87,579			40,268	37,750	60,674	58,156
Nursey - Middle block	280	1	852	3,567	3,673	3,567			2,501	2,449	3,332	3,280
Retail - West Block	407	1	1,025	684	20,325	684			7,552	5,896	7,711	6,056
TOTAL (Non-Residential)			17,714	135,743	92,864	135,743	70,749		66,153	102,377	97,781	
Area Weighted Average (/m2)							42.7		39.9	61.7	59.0	
Improvement over Target									6.5%		4.5%	

Appendix B

TER Worksheets for Representative Dwellings

TER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	1B MF NW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	48.45 (1a) x	2.70 (2a) =	130.82 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		48.45 (4)
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	130.82 (5)

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	2 x 10 =	20 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20 ÷ (5) = 0.15 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.31 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door			2.20 x	1.00 =	2.20		(26)
Window			9.67 x	1.33 =	12.82		(27)
External wall			30.65 x	0.18 =	5.52		(29a)
Party wall			45.30 x	0.00 =	0.00		(32)
Total area of external elements ΣA, m ²			42.52				(31)

Fabric heat loss, W/K = Σ(A x U)	(26)...(30) + (32) =	20.54	(33)
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Heat capacity Cm = Σ(A x k)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
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Thermal mass parameter (TMP) in kJ/m ² K		250.00	(35)
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Thermal bridges: Σ(L x Ψ) calculated using Appendix K		3.58	(36)
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Total fabric heat loss	(33) + (36) =	24.11	(37)
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	25.01	24.87	24.74	24.13	24.02	23.48	23.48	23.38	23.69	24.02	24.25	24.49

Heat transfer coefficient, W/K (37)m + (38)m	49.12	48.99	48.86	48.24	48.13	47.60	47.60	47.50	47.80	48.13	48.36	48.60
Average = Σ(39)1...12/12 =	48.24											

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.01	1.01	1.01	1.00	0.99	0.98	0.98	0.98	0.99	0.99	1.00	1.00
Average = Σ(40)1...12/12 =	1.00											

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00
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4. Water heating energy requirement

Assumed occupancy, N	1.64	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.26	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	80.58	77.65	74.72	71.79	68.86	65.93	65.93	68.86	71.79	74.72	77.65	80.58
Σ(44)1...12 =	879.10											

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	119.50	104.52	107.85	94.03	90.22	77.86	72.15	82.79	83.78	97.63	106.58	115.73
Σ(45)1...12 =	1152.64											

Distribution loss 0.15 x (45)m	17.93	15.68	16.18	14.10	13.53	11.68	10.82	12.42	12.57	14.65	15.99	17.36
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Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00	(47)
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Water storage loss:	1.37	(48)
a) If manufacturer's declared loss factor is known (kWh/day)	0.54	(49)

Temperature factor from Table 2b	0.74	(50)
Energy lost from water storage (kWh/day) (48) x (49)	0.74	(55)

Enter (50) or (54) in (55)

0.74 (55)

Water storage loss calculated for each month (55) x (41)m

22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Combi loss for each month from Table 3a, 3b or 3c													
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)	
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
165.64	146.19	153.99	138.68	136.36	122.51	118.28	128.93	128.43	143.77	151.22	161.87	(62)	
Solar DHW input calculated using Appendix G or Appendix H													
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)	
Output from water heater for each month (kWh/month) (62)m + (63)m													
165.64	146.19	153.99	138.68	136.36	122.51	118.28	128.93	128.43	143.77	151.22	161.87		
											Σ(64)1...12 =	1695.87	(64)
Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
76.64	68.09	72.77	66.98	66.91	61.61	60.90	64.44	63.57	69.37	71.16	75.39	(65)	

5. Internal gains												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
12.86	11.42	9.29	7.03	5.26	4.44	4.80	6.23	8.37	10.62	12.40	13.22	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
143.21	144.70	140.95	132.98	122.91	113.46	107.14	105.65	109.40	117.37	127.43	136.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	(69)
Pump and fan gains (Table 5a)												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)												
-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	(71)
Water heating gains (Table 5)												
103.02	101.33	97.81	93.03	89.93	85.56	81.85	86.61	88.30	93.24	98.83	101.33	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m												
309.76	308.11	298.72	283.71	268.77	254.13	244.45	249.16	256.73	271.90	289.33	302.11	(73)

6. Solar gains												
	Access factor Table 6d	Area m²	Solar flux W/m²		g specific data or Table 6b	FF specific data or Table 6c	Gains W					
NorthWest	0.77	x	9.67	x	11.28	x 0.9 x	0.63	x	0.70	=	33.34	(81)
Solar gains in watts Σ(74)m...(82)m												
33.34	67.87	122.29	200.83	269.95	287.80	269.23	214.63	149.01	82.95	41.96	27.23	(83)
Total gains - internal and solar (73)m + (83)m												
343.10	375.98	421.00	484.54	538.72	541.93	513.68	463.79	405.74	354.85	331.28	329.34	(84)

7. Mean internal temperature (heating season)												
Temperature during heating periods in the living area from Table 9, Th1(°C)											21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
1.00	0.99	0.98	0.92	0.76	0.55	0.41	0.47	0.75	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
20.05	20.17	20.41	20.72	20.93	20.99	21.00	21.00	20.95	20.68	20.31	20.03	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)													
20.07	20.07	20.08	20.09	20.09	20.10	20.10	20.10	20.09	20.09	20.08	20.08	(88)	
Utilisation factor for gains for rest of dwelling n2,m													
0.99	0.99	0.97	0.89	0.71	0.48	0.32	0.38	0.67	0.93	0.99	1.00	(89)	
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
18.81	18.99	19.33	19.77	20.02	20.09	20.10	20.10	20.06	19.72	19.21	18.79	(90)	
Living area fraction											Living area ÷ (4) =	0.45	(91)
Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2													
19.37	19.53	19.82	20.20	20.43	20.50	20.51	20.51	20.46	20.16	19.71	19.35	(92)	
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
19.37	19.53	19.82	20.20	20.43	20.50	20.51	20.51	20.46	20.16	19.71	19.35	(93)	

8. Space heating requirement													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, ηm													
0.99	0.99	0.97	0.89	0.73	0.51	0.36	0.42	0.71	0.94	0.99	0.99	(94)	
Useful gains, ηmGm, W (94)m x (84)m													
340.54	371.02	407.21	433.64	392.25	277.62	185.61	194.27	286.87	332.14	326.35	327.34	(95)	
Monthly average external temperature from Table U1													
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)	
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
740.35	716.61	650.87	545.33	420.28	280.82	185.96	195.07	304.14	459.95	609.82	736.33	(97)	
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
297.46	232.23	181.28	80.42	20.85	0.00	0.00	0.00	0.00	95.09	204.10	304.29		
											Σ(98)1...5, 10...12 =	1415.73	(98)
Space heating requirement kWh/m²/year											(98) ÷ (4) =	29.22	(99)

9a. Energy requirements - individual heating systems including micro-CHP													
Space heating													
Fraction of space heat from secondary/supplementary system (table 11)											0.00	(201)	
Fraction of space heat from main system(s)											1 - (201) =	1.00	(202)
Fraction of space heat from main system 2												0.00	(202)
Fraction of total space heat from main system 1											(202) x [1 - (203)] =	1.00	(204)
Fraction of total space heat from main system 2											(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)												93.50	(206)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating fuel (main system 1), kWh/month													
318.14	248.38	193.88	86.01	22.30	0.00	0.00	0.00	0.00	101.70	218.29	325.44		
											Σ(211)1...5, 10...12 =	1514.15	(211)

Water heating													
Efficiency of water heater													
86.36	86.04	85.25	83.42	81.07	79.80	79.80	79.80	79.80	83.74	85.61	86.47	(217)	
Water heating fuel, kWh/month													
191.81	169.91	180.64	166.24	168.20	153.52	148.22	161.56	160.93	171.68	176.63	187.19		
											Σ(219a)1...12 =	2036.53	(219)

Annual totals												
Space heating fuel - main system 1											1514.15	
Water heating fuel											2036.53	

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	227.11	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 3852.79	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1514.15	x	3.48	x 0.01 =	52.69	(240)
Water heating	2036.53	x	3.48	x 0.01 =	70.87	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	227.11	x	13.19	x 0.01 =	29.96	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	283.41	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.27	(257)
SAP value	82.23	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1514.15	x	0.216	=	327.06	(261)
Water heating	2036.53	x	0.216	=	439.89	(264)
Space and water heating			(261) + (262) + (263) + (264) =		766.95	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	227.11	x	0.519	=	117.87	(268)
Total CO ₂ , kg/year			(265)...(271) =		923.74	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		27.77	(273)
EI value					86.75	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1514.15	x	1.22	=	1847.26	(261)
Water heating	2036.53	x	1.22	=	2484.57	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4331.83	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	227.11	x	3.07	=	697.23	(268)
Primary energy kWh/year					5259.31	(272)
Dwelling primary energy rate kWh/m ² /year					108.55	(273)

TER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	1B MF SE x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	48.45	(1a) x	2.70	(2a) =	130.82	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 48.45					(4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 130.82					(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	$(6a) + (6b) + (7a) + (7b) + (7c) =$	20	$\div (5) =$	0.15 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(18)
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Number of sides on which the dwelling is sheltered	3	(19)
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Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.31	(21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37	(22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)
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d) natural ventilation or whole house positive input ventilation from loft	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.20	x 1.00	= 2.20		(26)						
Window			9.67	x 1.33	= 12.82		(27)						
External wall			30.65	x 0.18	= 5.52		(29a)						
Party wall			45.30	x 0.00	= 0.00		(32)						
Total area of external elements ΣA, m ²			42.52				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	20.54	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						250.00	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						3.58	(36)						
Total fabric heat loss					(33) + (36) =	24.11	(37)						
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.01	24.87	24.74	24.13	24.02	23.48	23.48	23.38	23.69	24.02	24.25	24.49	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.12	48.99	48.86	48.24	48.13	47.60	47.60	47.50	47.80	48.13	48.36	48.60	
	Average = Σ(39)1...12/12 = 48.24 (39)												
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.01	1.01	1.01	1.00	0.99	0.98	0.98	0.98	0.99	0.99	1.00	1.00	
	Average = Σ(40)1...12/12 = 1.00 (40)												
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.64	(42)
Annual average hot water usage in litres per day Vd,average = (25 × N) + 36	73.26	(43)
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	Jan 80.58 Feb 77.65 Mar 74.72 Apr 71.79 May 68.86 Jun 65.93 Jul 65.93 Aug 68.86 Sep 71.79 Oct 74.72 Nov 77.65 Dec 80.58	Σ(44)1...12 = 879.10 (44)
Energy content of hot water used = 4.18 × Vd,m × nm × Tm/3600 kWh/month (see Tables 1b, 1c 1d)	119.50 104.52 107.85 94.03 90.22 77.86 72.15 82.79 83.78 97.63 106.58 115.73	Σ(45)1...12 = 1152.64 (45)
Distribution loss 0.15 x (45)m	17.93 15.68 16.18 14.10 13.53 11.68 10.82 12.42 12.57 14.65 15.99 17.36	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.37	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.74	(50)
Enter (50) or (54) in (55)	0.74	(55)
Water storage loss calculated for each month (55) x (41)m	22.87 20.66 22.87 22.14 22.87 22.14 22.87 22.87 22.14 22.87 22.14 22.87	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	22.87 20.66 22.87 22.14 22.87 22.14 22.87 22.87 22.14 22.87 22.14 22.87	(57)
Primary circuit loss for each month from Table 3		

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.64	146.19	153.99	138.68	136.36	122.51	118.28	128.93	128.43	143.77	151.22	161.87	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

165.64	146.19	153.99	138.68	136.36	122.51	118.28	128.93	128.43	143.77	151.22	161.87		
											$\Sigma(64)1...12 =$	1695.87	(64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.64	68.09	72.77	66.98	66.91	61.61	60.90	64.44	63.57	69.37	71.16	75.39	(65)
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5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.86	11.42	9.29	7.03	5.26	4.44	4.80	6.23	8.37	10.62	12.40	13.22	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	143.21	144.70	140.95	132.98	122.91	113.46	107.14	105.65	109.40	117.37	127.43	136.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	(71)
Water heating gains (Table 5)	103.02	101.33	97.81	93.03	89.93	85.56	81.85	86.61	88.30	93.24	98.83	101.33	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	309.76	308.11	298.72	283.71	268.77	254.13	244.45	249.16	256.73	271.90	289.33	302.11	(73)

6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W							
SouthEast	0.77	x 9.67	x 36.79	x 0.9 x 0.63	x 0.70	= 108.74 (77)							
Solar gains in watts Σ(74)m...(82)m	108.74	185.22	253.42	314.00	351.71	349.17	336.63	308.50	274.40	204.70	130.24	93.06	(83)
Total gains - internal and solar (73)m + (83)m	418.49	493.33	552.14	597.72	620.48	603.29	581.09	557.66	531.13	476.61	419.57	395.16	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00	(85)											
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.93	0.84	0.69	0.50	0.36	0.39	0.60	0.87	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.19	20.38	20.61	20.84	20.96	20.99	21.00	21.00	20.98	20.83	20.47	20.15	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.07	20.07	20.08	20.09	20.09	20.10	20.10	20.10	20.09	20.09	20.08	20.08	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.91	0.80	0.63	0.43	0.29	0.31	0.53	0.83	0.96	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.02	19.29	19.61	19.91	20.05	20.09	20.10	20.10	20.08	19.91	19.43	18.97	(90)
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Living area fraction Living area ÷ (4) = 0.45 (91)

Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2

19.55	19.79	20.07	20.33	20.46	20.50	20.51	20.51	20.49	20.33	19.90	19.51	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.55	19.79	20.07	20.33	20.46	20.50	20.51	20.51	20.49	20.33	19.90	19.51	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.98	0.96	0.91	0.81	0.65	0.46	0.32	0.35	0.56	0.84	0.96	0.99	(94)

Useful gains, ηmGm, W (94)m x (84)m

411.10	473.82	504.75	486.21	405.28	279.06	185.80	194.82	299.83	401.41	403.27	389.77	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

749.09	729.37	662.93	551.55	421.71	280.98	185.99	195.13	305.55	468.23	619.27	743.99	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

251.46	171.73	117.69	47.04	12.23	0.00	0.00	0.00	0.00	49.72	155.52	263.54	
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Σ(98)1...5, 10...12 = 1068.93 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 22.06 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 93.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
268.95	183.67	125.87	50.31	13.08	0.00	0.00	0.00	0.00	53.17	166.33	281.86	
Σ(211)1...5, 10...12 =												1143.24 (211)

Water heating

Efficiency of water heater

85.92	85.24	84.11	82.26	80.58	79.80	79.80	79.80	79.80	82.30	84.89	86.11	(217)
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Water heating fuel, kWh/month

192.78	171.50	183.09	168.58	169.22	153.52	148.22	161.56	160.93	174.69	178.14	187.99	
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Σ(219a)1...12 = 2050.22 (219)

Annual totals

Space heating fuel - main system 1 1143.24
Water heating fuel 2050.22

Electricity for pumps, fans and electric keep-hot (Table 4f)

central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	227.11	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 3495.57	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1143.24	x	3.48	x 0.01 =	39.78	(240)
Water heating	2050.22	x	3.48	x 0.01 =	71.35	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	227.11	x	13.19	x 0.01 =	29.96	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		270.98	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.22	(257)
SAP value	83.01	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1143.24	x	0.216	=	246.94	(261)
Water heating	2050.22	x	0.216	=	442.85	(264)
Space and water heating			(261) + (262) + (263) + (264) =		689.79	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	227.11	x	0.519	=	117.87	(268)
Total CO ₂ , kg/year			(265)...(271) =		846.58	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		25.30	(273)
EI value					87.86	
EI rating (section 14)					88	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1143.24	x	1.22	=	1394.75	(261)
Water heating	2050.22	x	1.22	=	2501.26	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3896.02	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	227.11	x	3.07	=	697.23	(268)
Primary energy kWh/year					4823.50	(272)
Dwelling primary energy rate kWh/m2/year					99.56	(273)

TER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	2B Exp NW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	63.36 (1a) x	2.70 (2a) =	171.07 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) = 171.07 (5)	

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	2 x 10 =	20 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20 ÷ (5) =	0.12 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.28 (21)
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Infiltration rate modified for monthly wind speed:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

 (22)

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18
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 (22a)

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.36	0.36	0.35	0.31	0.31	0.27	0.27	0.26	0.28	0.31	0.32	0.33
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 (22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
--	--

d) natural ventilation or whole house positive input ventilation from loft	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56
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 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56
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 (25)

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door	2.20	x	1.00	=	2.20		(26)
Window	13.04	x	1.33	=	17.29		(27)
Exposed floor	63.36	x	0.13	=	8.24		(28b)
External wall	45.84	x	0.18	=	8.25		(29a)
Party wall	45.30	x	0.00	=	0.00		(32)
Total area of external elements ΣA, m ²	124.44						(31)

Fabric heat loss, W/K = Σ(A x U)	(26)...(30) + (32) =	35.98	(33)
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Heat capacity Cm = Σ(A x k)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
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Thermal mass parameter (TMP) in kJ/m ² K		250.00	(35)
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Thermal bridges: Σ(L x Ψ) calculated using Appendix K		10.85	(36)
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Total fabric heat loss	(33) + (36) =	46.83	(37)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31.94	31.79	31.65	30.99	30.86	30.29	30.29	30.18	30.51	30.86	31.12	31.38

 (38)

Heat transfer coefficient, W/K (37)m + (38)m												
78.76	78.62	78.48	77.81	77.69	77.11	77.11	77.01	77.34	77.69	77.94	78.20	
Average = $\sum(39)1...12/12 =$											77.81	(39)

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.24	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23
Average = Σ(40)1...12/12 =	1.23										

 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00
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 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.07	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.48	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83
Σ(44)1...12 =											1001.74

 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88		
											Σ(45)1...12 =	1313.44	(45)

Distribution loss 0.15 x (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78
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 (46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00	(47)
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Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.37	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.74	(50)
Enter (50) or (54) in (55)	0.74	(55)

Water storage loss calculated for each month (55) x (41)m	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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 (57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)\text{m} + (46)\text{m} + (57)\text{m} + (59)\text{m} + (61)\text{m}$

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	
$\Sigma(64)1...12 =$											1856.66	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$

82.19	72.94	77.77	71.35	71.09	65.22	64.24	68.28	67.46	73.90	76.10	80.76	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

16.24	14.42	11.73	8.88	6.64	5.60	6.05	7.87	10.56	13.41	15.65	16.69	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	173.33	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
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Losses e.g. evaporation (Table 5)

-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	(71)
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Water heating gains (Table 5)

110.47	108.54	104.53	99.09	95.56	90.58	86.35	91.77	93.70	99.33	105.69	108.55	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

365.16	363.30	351.86	333.47	314.95	296.97	285.19	290.54	299.90	318.48	339.83	355.69	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W
NorthWest	0.77	13.04	11.28	0.63	0.70	44.96 (81)

Solar gains in watts $\Sigma(74)\text{m}...(82)\text{m}$

44.96	91.53	164.90	270.82	364.03	388.10	363.06	289.43	200.94	111.85	56.58	36.72	(83)
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Total gains - internal and solar (73)m + (83)m

410.13	454.83	516.76	604.29	678.98	685.06	648.24	579.97	500.84	430.33	396.40	392.41	(84)
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7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

1.00	0.99	0.99	0.95	0.85	0.67	0.51	0.59	0.85	0.98	0.99	1.00	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.68	19.81	20.08	20.47	20.79	20.95	20.99	20.98	20.84	20.43	19.99	19.65	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.89	19.89	19.89	19.90	19.90	19.91	19.91	19.91	19.90	19.90	19.90	19.89	(88)
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Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.94	0.80	0.58	0.39	0.46	0.78	0.96	0.99	1.00	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.14	18.34	18.73	19.28	19.70	19.88	19.90	19.90	19.78	19.24	18.60	18.11	(90)
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Living area fraction

Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2

18.68	18.85	19.20	19.69	20.08	20.25	20.28	20.28	20.15	19.66	19.09	18.65	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.68	18.85	19.20	19.69	20.08	20.25	20.28	20.28	20.15	19.66	19.09	18.65	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.99	0.98	0.93	0.81	0.61	0.43	0.50	0.80	0.96	0.99	1.00	(94)

Useful gains, ηmGm, W (94)m x (84)m

407.96	450.66	505.43	562.80	549.28	416.30	280.89	292.48	399.71	413.37	392.54	390.72	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x ((93)m - (96)m)]

1132.28	1096.90	996.82	839.72	650.94	435.75	283.94	298.56	467.90	703.64	934.45	1129.73	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)\text{m} - (95)\text{m}] \times (41)\text{m}$

538.89	434.27	365.60	199.38	75.64	0.00	0.00	0.00	0.00	215.96	390.18	549.82	
$\Sigma(98)1...5, 10...12 =$											2769.74	(98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 43.71 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	93.50	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
576.35	464.46	391.01	213.25	80.89	0.00	0.00	0.00	0.00	230.98	417.30	588.04	
$\Sigma(211)1...5, 10...12 =$											2962.29	(211)

Water heating

Efficiency of water heater												
87.53	87.34	86.82	85.54	83.11	79.80	79.80	79.80	79.80	85.66	87.02	87.63	(217)

Water heating fuel, kWh/month

208.28	184.08	194.70	177.45	179.22	167.13	160.84	176.03	175.58	183.74	190.87	203.15	
$\Sigma(219a)1...12 =$											2201.08	(219)

Annual totals

Space heating fuel - main system 1	2962.29
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Water heating fuel		2201.08	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		286.73	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5525.09	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2962.29	x	3.48	x 0.01 =	103.09	(240)
Water heating	2201.08	x	3.48	x 0.01 =	76.60	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	286.73	x	13.19	x 0.01 =	37.82	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		347.40	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.35	(257)
SAP value	81.22	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2962.29	x	0.216	=	639.85	(261)
Water heating	2201.08	x	0.216	=	475.43	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1115.29	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	286.73	x	0.519	=	148.81	(268)
Total CO ₂ , kg/year			(265)...(271) =		1303.02	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		30.25	(273)
EI value					83.89	
EI rating (section 14)					84	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2962.29	x	1.22	=	3613.99	(261)
Water heating	2201.08	x	1.22	=	2685.31	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6299.30	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	286.73	x	3.07	=	880.26	(268)
Primary energy kWh/year					7409.81	(272)
Dwelling primary energy rate kWh/m ² /year					116.95	(273)

TER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	2B MF NWSW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	63.36	(1a) x	2.70	(2a) =	171.07	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36	(4)				
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		171.07	(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20	÷ (5) =	0.12	(8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(18)
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Number of sides on which the dwelling is sheltered	2	(19)
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Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
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Infiltration rate incorporating shelter factor	(18) x (20) =	0.31	(21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)

Wind factor (22)m ÷ 4

	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

	0.40	0.39	0.38	0.34	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37	(22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)
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d) natural ventilation or whole house positive input ventilation from loft

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.20	x 1.00	= 2.20		(26)						
Window			13.63	x 1.33	= 18.07		(27)						
External wall			45.68	x 0.18	= 8.22		(29a)						
Party wall			22.21	x 0.00	= 0.00		(32)						
Total area of external elements ΣA, m ²			61.51				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) = 28.49		(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) = N/A		(34)						
Thermal mass parameter (TMP) in kJ/m ² K					250.00		(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K					5.36		(36)						
Total fabric heat loss					(33) + (36) = 33.85		(37)						
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	32.69	32.52	32.35	31.55	31.40	30.70	30.70	30.58	30.97	31.40	31.70	32.02	(38)
Heat transfer coefficient, W/K (37)m + (38)m	66.54	66.37	66.20	65.40	65.25	64.55	64.55	64.43	64.82	65.25	65.55	65.87	
	Average = Σ(39)1...12/12 = 65.40												(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.05	1.05	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.03	1.03	1.04	
	Average = Σ(40)1...12/12 = 1.03												(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.07	(42)											
Annual average hot water usage in litres per day Vd,average = (25 × N) + 36	83.48	(43)											
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83	
	Σ(44)1...12 = 1001.74												(44)
Energy content of hot water used = 4.18 × Vd,m × nm × Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88	
	Σ(45)1...12 = 1313.44												(45)
Distribution loss 0.15 x (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00												(47)
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)	1.37												(48)
Temperature factor from Table 2b	0.54												(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.74												(50)
Enter (50) or (54) in (55)	0.74												(55)
Water storage loss calculated for each month (55) x (41)m	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87	(57)
Primary circuit loss for each month from Table 3													

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
------	------	------	------	------	------	------	------	------	------	------	------	------

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	
											Σ(64)1...12 = 1856.66	(64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

82.19	72.94	77.77	71.35	71.09	65.22	64.24	68.28	67.46	73.90	76.10	80.76	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.19	14.38	11.69	8.85	6.62	5.59	6.04	7.85	10.53	13.37	15.61	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	(71)
Water heating gains (Table 5)	110.47	108.54	104.53	99.09	95.56	90.58	86.35	91.77	93.70	99.33	105.69	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	365.11	363.26	351.82	333.45	314.93	296.95	285.17	290.52	299.87	318.44	339.78	(73)

6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W							
NorthWest	0.77	x 3.98	x 11.28	x 0.9 x 0.63	x 0.70	= 13.72	(81)						
SouthWest	0.77	x 9.65	x 36.79	x 0.9 x 0.63	x 0.70	= 108.51	(79)						
Solar gains in watts Σ(74)m...(82)m	122.23	212.77	303.23	396.01	462.09	466.90	446.75	396.20	335.16	238.42	147.24	104.07	(83)
Total gains - internal and solar (73)m + (83)m	487.35	576.03	655.05	729.46	777.02	763.85	731.92	686.72	635.03	556.86	487.02	459.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.96	0.88	0.73	0.53	0.39	0.43	0.67	0.92	0.98	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													

20.05	20.24	20.50	20.77	20.94	20.99	21.00	21.00	20.97	20.74	20.35	20.02	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)												
20.04	20.04	20.05	20.06	20.06	20.07	20.07	20.07	20.06	20.06	20.05	20.05	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.98	0.94	0.85	0.67	0.46	0.31	0.34	0.59	0.89	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
18.79	19.07	19.43	19.81	20.00	20.06	20.07	20.07	20.04	19.78	19.23	18.75	(90)
Living area fraction												
Living area ÷ (4) =											0.35	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												
19.23	19.48	19.80	20.14	20.33	20.39	20.39	20.39	20.37	20.12	19.62	19.19	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate												
19.23	19.48	19.80	20.14	20.33	20.39	20.39	20.39	20.37	20.12	19.62	19.19	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.97	0.94	0.85	0.69	0.48	0.33	0.37	0.62	0.89	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m												
482.02	561.48	615.51	619.44	532.84	369.86	244.44	256.56	393.02	494.64	475.24	455.89	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
993.69	967.46	880.54	735.32	562.93	373.51	244.82	257.25	406.11	621.14	820.65	987.51	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
380.68	272.82	197.18	83.44	22.39	0.00	0.00	0.00	0.00	94.11	248.69	395.53	
Σ(98)1...5, 10...12 =											1694.84	(98)
Space heating requirement kWh/m²/year											(98) ÷ (4)	26.75 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating												
Fraction of space heat from secondary/supplementary system (table 11)												0.00 (201)
Fraction of space heat from main system(s)												1 - (201) = 1.00 (202)
Fraction of space heat from main system 2												0.00 (202)
Fraction of total space heat from main system 1												(202) x [1- (203)] = 1.00 (204)
Fraction of total space heat from main system 2												(202) x (203) = 0.00 (205)
Efficiency of main system 1 (%)												93.50 (206)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
407.14	291.78	210.89	89.24	23.95	0.00	0.00	0.00	0.00	100.65	265.98	423.02	
Σ(211)1...5, 10...12 =											1812.66	(211)

Water heating												
Efficiency of water heater												
86.73	86.21	85.23	83.29	81.05	79.80	79.80	79.80	79.80	83.49	85.89	86.88	(217)
Water heating fuel, kWh/month												
210.20	186.48	198.34	182.24	183.77	167.13	160.84	176.03	175.58	188.51	193.38	204.89	
Σ(219a)1...12 =											2227.38	(219)
Annual totals												
Space heating fuel - main system 1												1812.66

Water heating fuel			2227.38	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit	30.00			(230c)
boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			285.86	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =		4400.90	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1812.66	x	3.48	x 0.01 =	63.08	(240)
Water heating	2227.38	x	3.48	x 0.01 =	77.51	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	285.86	x	13.19	x 0.01 =	37.71	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		308.19	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.19	(257)
SAP value	83.34	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1812.66	x	0.216	=	391.53	(261)
Water heating	2227.38	x	0.216	=	481.11	(264)
Space and water heating			(261) + (262) + (263) + (264) =		872.65	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	285.86	x	0.519	=	148.36	(268)
Total CO ₂ , kg/year			(265)...(271) =		1059.94	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		24.30	(273)
EI value					86.89	
EI rating (section 14)					87	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1812.66	x	1.22	=	2211.44	(261)
Water heating	2227.38	x	1.22	=	2717.40	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4928.85	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	285.86	x	3.07	=	877.60	(268)
Primary energy kWh/year					6036.69	(272)
Dwelling primary energy rate kWh/m2/year					95.28	(273)

TER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	2B TF SESW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	63.36 (1a) x	2.70 (2a) =	171.07 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	171.07 (5)

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	2 x 10 =	20 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 20 ÷ (5) = 0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
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Number of sides on which the dwelling is sheltered	2 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.85 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.31 (21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.40	0.39	0.38	0.34	0.34	0.30	0.30	0.29	0.31	0.34	0.35	0.37
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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d) natural ventilation or whole house positive input ventilation from loft	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door			2.20 x	1.00 =	2.20		(26)
Window			13.63 x	1.33 =	18.07		(27)
External wall			45.68 x	0.18 =	8.22		(29a)
Party wall			22.21 x	0.00 =	0.00		(32)
Roof			63.36 x	0.13 =	8.24		(30)
Total area of external elements ΣA, m ²			124.87				(31)

Fabric heat loss, W/K = Σ(A x U)	(26)...(30) + (32) =	36.73	(33)
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Heat capacity Cm = Σ(A x k)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
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Thermal mass parameter (TMP) in kJ/m ² K		250.00	(35)
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Thermal bridges: Σ(L x Ψ) calculated using Appendix K		14.59	(36)
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Total fabric heat loss	(33) + (36) =	51.32	(37)
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	32.69	32.52	32.35	31.55	31.40	30.70	30.70	30.58	30.97	31.40	31.70	32.02

Heat transfer coefficient, W/K (37)m + (38)m	84.01	83.83	83.67	82.87	82.72	82.02	82.02	81.89	82.29	82.72	83.02	83.34
Average = Σ(39)1...12/12 =	82.87											

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.33	1.32	1.32	1.31	1.31	1.29	1.29	1.29	1.30	1.31	1.31	1.32
Average = Σ(40)1...12/12 =	1.31											

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00
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4. Water heating energy requirement

Assumed occupancy, N	2.07	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.48	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83
Σ(44)1...12 =	1001.74											

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88
Σ(45)1...12 =	1313.44											

Distribution loss 0.15 x (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78
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Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00	(47)
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Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.37	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.74	(50)
Enter (50) or (54) in (55)	0.74	(55)

Water storage loss calculated for each month (55) x (41)m	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)\text{m} + (46)\text{m} + (57)\text{m} + (59)\text{m} + (61)\text{m}$

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) $(62)\text{m} + (63)\text{m}$

182.31	160.77	169.04	151.80	148.95	133.37	128.35	140.47	140.11	157.39	166.09	178.02	
$\Sigma(64)1...12 =$											1856.66	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$

82.19	72.94	77.77	71.35	71.09	65.22	64.24	68.28	67.46	73.90	76.10	80.76	(65)
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5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

16.19	14.38	11.69	8.85	6.62	5.59	6.04	7.85	10.53	13.37	15.61	16.64	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	173.33	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(69)
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Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	(71)
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Water heating gains (Table 5)

110.47	108.54	104.53	99.09	95.56	90.58	86.35	91.77	93.70	99.33	105.69	108.55	(72)
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Total internal gains $(66)\text{m} + (67)\text{m} + (68)\text{m} + (69)\text{m} + (70)\text{m} + (71)\text{m} + (72)\text{m}$

365.11	363.26	351.82	333.45	314.93	296.95	285.17	290.52	299.87	318.44	339.78	355.64	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W		
SouthEast	0.77	x	3.98	x	36.79	x 0.9 x	0.63	x	0.70	=	44.75	(77)	
SouthWest	0.77	x	9.65	x	36.79	x 0.9 x	0.63	x	0.70	=	108.51	(79)	
Solar gains in watts $\Sigma(74)\text{m}...(82)\text{m}$													
	153.26	261.07	357.20	442.59	495.74	492.15	474.49	434.84	386.78	288.53	183.58	131.16	(83)
Total gains - internal and solar (73)m + (83)m													
	518.38	624.32	709.03	776.04	810.67	789.10	759.66	725.36	686.64	606.97	523.35	486.80	(84)

7. Mean internal temperature (heating season)

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

												21.00	(85)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.98	0.96	0.91	0.80	0.63	0.47	0.51	0.73	0.93	0.98	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.72	19.94	20.24	20.57	20.82	20.96	20.99	20.99	20.91	20.57	20.08	19.68	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.82	19.82	19.82	19.83	19.84	19.85	19.85	19.85	19.84	19.84	19.83	19.83	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.88	0.74	0.53	0.35	0.39	0.64	0.90	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.16	18.47	18.89	19.36	19.68	19.82	19.84	19.84	19.78	19.38	18.68	18.10	(90)
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Living area fraction Living area ÷ (4) =

temperature for the whole dwelling $fLA \times T1 + (1 - fLA) \times T2$

18.70	18.99	19.36	19.78	20.08	20.22	20.24	20.24	20.17	19.79	19.17	18.65	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.70	18.99	19.36	19.78	20.08	20.22	20.24	20.24	20.17	19.79	19.17	18.65	(93)
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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.97	0.94	0.88	0.75	0.56	0.39	0.43	0.67	0.90	0.97	0.99	(94)

Useful gains, ηmGm, W (94)m x (84)m

511.74	607.08	668.00	679.12	608.07	443.45	296.28	310.70	461.25	545.39	509.83	481.94	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1210.13	1180.98	1076.11	901.70	692.88	460.62	298.83	314.61	499.70	760.55	1002.16	1204.54	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)\text{m} - (95)\text{m}] \times (41)\text{m}$

519.60	385.66	303.64	160.26	63.10	0.00	0.00	0.00	0.00	160.08	354.47	537.61	
$\Sigma(98)1...5, 10...12 =$											2484.43	(98)

Space heating requirement kWh/m²/year (98) ÷ (4)

												39.21	(99)
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9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	555.72	412.47	324.74	171.40	67.49	0.00	0.00	0.00	0.00	171.21	379.12	574.99	
	$\Sigma(211)1...5, 10...12 =$											2657.14	(211)

Water heating

Efficiency of water heater	87.45	87.07	86.36	84.96	82.71	79.80	79.80	79.80	79.80	84.86	86.79	87.58	(217)
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Water heating fuel, kWh/month

208.47	184.66	195.74	178.67	180.08	167.13	160.84	176.03	175.58	185.47	191.38	203.26	
$\Sigma(219a)1...12 =$											2207.30	(219)

Annual totals

Space heating fuel - main system 1			2657.14	
Water heating fuel			2207.30	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit		30.00		(230c)
boiler flue fan		45.00		(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			285.86	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =		5225.31	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2657.14	x	3.48	x 0.01 =	92.47	(240)
Water heating	2207.30	x	3.48	x 0.01 =	76.81	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	285.86	x	13.19	x 0.01 =	37.71	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	336.88	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)		1.31	(257)
SAP value		81.78	
SAP rating (section 13)		82	(258)
SAP band		B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2657.14	x	0.216	=	573.94	(261)
Water heating	2207.30	x	0.216	=	476.78	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1050.72	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	285.86	x	0.519	=	148.36	(268)
Total CO ₂ , kg/year			(265)...(271) =		1238.01	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		28.66	(273)
EI value					84.69	
EI rating (section 14)					85	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2657.14	x	1.22	=	3241.72	(261)
Water heating	2207.30	x	1.22	=	2692.91	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5934.63	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	285.86	x	3.07	=	877.60	(268)
Primary energy kWh/year					7042.47	(272)
Dwelling primary energy rate kWh/m ² /year					111.15	(273)

TER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	3B TF SESW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	83.79 (1a)	x	2.70 (2a)	=	226.23	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 83.79 (4)					
Dwelling volume			(3a) + (3b) + (3c) + (3d)...(3n) =		226.23	(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 30	÷ (5) = 0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.38	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.33	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)

Wind factor (22)m ÷ 4

1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

0.41	0.41	0.40	0.36	0.35	0.31	0.31	0.30	0.33	0.35	0.37	0.38	(22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

N/A (23c)

d) natural ventilation or whole house positive input ventilation from loft

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.20	x 1.00	= 2.20			(26)					
Window			18.42	x 1.33	= 24.42			(27)					
External wall			77.03	x 0.18	= 13.87			(29a)					
Party wall			27.18	x 0.00	= 0.00			(32)					
Roof			83.79	x 0.13	= 10.89			(30)					
Total area of external elements ΣA, m ²			181.44					(31)					
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	51.38		(33)					
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A		(34)					
Thermal mass parameter (TMP) in kJ/m ² K						250.00		(35)					
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						18.25		(36)					
Total fabric heat loss					(33) + (36) =	69.63		(37)					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	43.75	43.50	43.25	42.11	41.89	40.89	40.89	40.71	41.28	41.89	42.33	42.78	(38)
Heat transfer coefficient, W/K (37)m + (38)m	113.38	113.13	112.88	111.73	111.52	110.52	110.52	110.34	110.91	111.52	111.95	112.41	
	Average = Σ(39)1...12/12 =												111.73 (39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.35	1.35	1.35	1.33	1.33	1.32	1.32	1.32	1.32	1.33	1.34	1.34	
	Average = Σ(40)1...12/12 =												1.33 (40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.53												(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$	94.31												(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$	103.74	99.97	96.19	92.42	88.65	84.88	84.88	88.65	92.42	96.19	99.97	103.74		
	$\Sigma(44)1...12 =$												1131.69	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)	153.84	134.55	138.84	121.05	116.15	100.23	92.87	106.58	107.85	125.69	137.20	148.99		
	$\Sigma(45)1...12 =$												1483.83	(45)
Distribution loss $0.15 \times (45)m$	23.08	20.18	20.83	18.16	17.42	15.03	13.93	15.99	16.18	18.85	20.58	22.35		
														(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel													145.00	(47)
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)													1.37	(48)
Temperature factor from Table 2b													0.54	(49)
Energy lost from water storage (kWh/day) $(48) \times (49)$													0.74	(50)
Enter (50) or (54) in (55)													0.74	(55)
Water storage loss calculated for each month $(55) \times (41)m$	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87		
														(56)
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$, else (56)	22.87	20.66	22.87	22.14	22.87	22.14	22.87	22.87	22.14	22.87	22.14	22.87		
														(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for each month from Table 3a, 3b or 3c												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m												
199.98	176.22	184.98	165.70	162.29	144.88	139.01	152.71	152.50	171.82	181.85	195.12	(62)
Solar DHW input calculated using Appendix G or Appendix H												
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m												
199.98	176.22	184.98	165.70	162.29	144.88	139.01	152.71	152.50	171.82	181.85	195.12	
											Σ(64)1...12 =	2027.05 (64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]												
88.06	78.08	83.08	75.97	75.53	69.04	67.79	72.35	71.58	78.70	81.34	86.45	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.26	18.00	14.63	11.08	8.28	6.99	7.56	9.82	13.18	16.74	19.53	20.82	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	227.18	229.54	223.60	210.95	194.98	179.98	169.96	167.60	173.54	186.19	202.15	217.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	(71)
Water heating gains (Table 5)	118.36	116.18	111.66	105.51	101.52	95.90	91.12	97.24	99.41	105.78	112.97	116.19	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	429.77	427.68	413.85	391.50	368.75	346.83	332.59	338.62	350.10	372.67	398.62	418.14	(73)

6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	5.38	x	36.79	x 0.9 x	0.63	x	0.70	=	60.50	(77)
SouthWest	0.77	x	13.04	x	36.79	x 0.9 x	0.63	x	0.70	=	146.63	(79)
Solar gains in watts Σ(74)m...(82)m												
	207.13	352.81	482.74	598.13	669.96	665.11	641.24	587.65	522.70	389.93	248.09	177.26 (83)
Total gains - internal and solar (73)m + (83)m												
	636.89	780.49	896.59	989.63	1038.70	1011.94	973.83	926.28	872.80	762.60	646.71	595.39 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00												(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.99	0.97	0.92	0.82	0.65	0.49	0.53	0.76	0.94	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.64	19.86	20.17	20.52	20.80	20.95	20.99	20.98	20.89	20.52	20.01	19.60	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.80	19.80	19.80	19.81	19.82	19.83	19.83	19.83	19.82	19.82	19.81	19.81	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.96	0.89	0.76	0.55	0.36	0.40	0.67	0.92	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.02	18.35	18.78	19.28	19.63	19.79	19.82	19.82	19.74	19.29	18.56	17.96	(90)
Living area fraction	Living area ÷ (4) = 0.29												(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.48	18.78	19.18	19.63	19.96	20.12	20.16	20.15	20.07	19.64	18.98	18.43	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.48	18.78	19.18	19.63	19.96	20.12	20.16	20.15	20.07	19.64	18.98	18.43	(93)

8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, η_m	0.99	0.98	0.95	0.89	0.77	0.58	0.40	0.44	0.69	0.91	0.98	0.99
Useful gains, $\eta_m G_m$, W (94)m x (84)m	630.44	762.33	850.94	877.01	794.97	583.97	389.01	408.02	603.09	694.75	633.14	590.78
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
Heat loss rate for mean internal temperature, L_m , W [(39)m x [(93)m - (96)m]	1607.84	1570.12	1431.22	1199.29	921.35	610.37	392.94	414.13	662.18	1008.59	1329.50	1599.71
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	727.19	542.84	431.73	232.04	94.02	0.00	0.00	0.00	0.00	233.49	501.38	750.64
	$\Sigma(98)1...5, 10...12 =$										3513.32	
Space heating requirement kWh/m ² /year	$(98) \div (4) =$										41.93	

9a. Energy requirements - individual heating systems including micro-CHP															
Space heating															
Fraction of space heat from secondary/supplementary system (table 11)												0.00	(201)		
Fraction of space heat from main system(s)												1 - (201) =	1.00	(202)	
Fraction of space heat from main system 2													0.00	(202)	
Fraction of total space heat from main system 1												(202) x [1- (203)] =	1.00	(204)	
Fraction of total space heat from main system 2												(202) x (203) =	0.00	(205)	
Efficiency of main system 1 (%)													93.50	(206)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating fuel (main system 1), kWh/month															
	777.74	580.57	461.74	248.17	100.56	0.00	0.00	0.00	0.00	249.73	536.23	802.83			
													Σ(211)1...5, 10...12 =	3757.56	(211)

Water heating													
Efficiency of water heater													
87.96	87.62	87.00	85.71	83.42	79.80	79.80	79.80	79.80	85.63	87.38	88.06	(217)	
Water heating fuel, kWh/month													
227.36	201.12	212.62	193.32	194.54	181.55	174.20	191.37	191.10	200.65	208.11	221.57		
											Σ(219a)1...12 =	2397.51	(219)

Annual totals

Space heating fuel - main system 1			3757.56	
Water heating fuel			2397.51	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit		30.00		(230c)
boiler flue fan		45.00		(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			357.81	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =		6587.88	(238)

10a. Fuel costs - individual heating systems including micro-CHP						
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3757.56	x	3.48	x 0.01 =	130.76	(240)
Water heating	2397.51	x	3.48	x 0.01 =	83.43	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	357.81	x	13.19	x 0.01 =	47.20	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	391.28	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.20	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO ₂ emissions - individual heating systems including micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year
Space heating - main system 1	3757.56	x	0.216	=	811.63 (261)
Water heating	2397.51	x	0.216	=	517.86 (264)
Space and water heating			(261) + (262) + (263) + (264) =		1329.49 (265)
Pumps and fans	75.00	x	0.519	=	38.93 (267)
Electricity for lighting	357.81	x	0.519	=	185.70 (268)
Total CO ₂ , kg/year				(265)...(271) =	1554.12 (272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	27.27 (273)
EI value					83.83
EI rating (section 14)					84 (274)
EI band					B

13a. Primary energy - individual heating systems including micro-CHP						
	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3757.56	x	1.22	=	4584.22	(261)
Water heating	2397.51	x	1.22	=	2924.96	(264)
Space and water heating				(261) + (262) + (263) + (264) =	7509.18	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	357.81	x	3.07	=	1098.47	(268)
Primary energy kWh/year					8837.91	(272)
Dwelling primary energy rate kWh/m2/year					105.48	(273)

Appendix C

DER Worksheets for Representative Dwellings

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	12/08/2019
Address	1B MF NW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	48.45 (1a) x	2.70 (2a) =	130.82 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 48.45 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	130.82 (5)

2. Ventilation rate

	m ³ per hour
Number of chimneys	0 x 40 = 0 (6a)
Number of open flues	0 x 20 = 0 (6b)
Number of intermittent fans	0 x 10 = 0 (7a)
Number of passive vents	0 x 10 = 0 (7b)
Number of flueless gas fires	0 x 40 = 0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0 ÷ (5) = 0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.19 (21)
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Infiltration rate modified for monthly wind speed:											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70
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Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.19	0.21	0.22	0.23
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Calculate effective air change rate for the applicable case:	
If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)

c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door			2.20	1.00	2.20		
Window			9.67	1.33	12.82		
External wall			30.65	0.17	5.21		
Party wall			45.30	0.00	0.00		
Total area of external elements ΣA, m ²			42.52				

Fabric heat loss, W/K = Σ(A x U)	(26)...(30) + (32) =	20.23 (33)
Heat capacity Cm = Σ(A x k)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m ² K		100.00 (35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K		6.61 (36)
Total fabric heat loss	(33) + (36) =	26.84 (37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21.58	21.58	21.58	21.58	21.58	21.58	21.58	21.58	21.58	21.58	21.58	21.58

Heat transfer coefficient, W/K (37)m + (38)m	48.43	48.43	48.43	48.43	48.43	48.43	48.43	48.43	48.43	48.43	48.43
Average = Σ(39)1...12/12 =	48.43 (39)										

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average = Σ(40)1...12/12 =	1.00 (40)										

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	31.00
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4. Water heating energy requirement

Assumed occupancy, N	1.64 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	73.26 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80.58	77.65	74.72	71.79	68.86	65.93	65.93	68.86	71.79	74.72	77.65	80.58
Σ(44)1...12 =											879.10 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	119.50	104.52	107.85	94.03	90.22	77.86	72.15	82.79	83.78	97.63	106.58	115.73
Σ(45)1...12 =	1152.64 (45)											

Distribution loss 0.15 x (45)m	17.93	15.68	16.18	14.10	13.53	11.68	10.82	12.42	12.57	14.65	15.99	17.36
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Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00 (47)											
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Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.18 (48)
Temperature factor from Table 2b	0.60 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71 (50)
Enter (50) or (54) in (55)	0.71 (55)

Water storage loss calculated for each month (55) x (41)m	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95
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Primary circuit loss for each month from Table 3

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)	
Combi loss for each month from Table 3a, 3b or 3c														
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)	
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m														
	141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68	(62)	
Solar DHW input calculated using Appendix G or Appendix H														
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)	
Output from water heater for each month (kWh/month) (62)m + (63)m														
	141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68		
												$\Sigma(64)1...12 =$	1411.06	(64)
Heat gains from water heating (kWh/month) 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]														
	57.29	50.61	53.42	48.26	47.56	42.88	41.55	45.09	44.85	50.02	52.43	56.04	(65)	

5. Internal gains													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)													
	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	12.77	11.34	9.22	6.98	5.22	4.41	4.76	6.19	8.31	10.55	12.31	13.12	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	143.21	144.70	140.95	132.98	122.91	113.46	107.14	105.65	109.40	117.37	127.43	136.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	(69)
Pump and fan gains (Table 5a)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)													
	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	(71)
Water heating gains (Table 5)													
	77.01	75.32	71.80	67.02	63.92	59.55	55.84	60.60	62.29	67.23	72.82	75.32	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
	280.65	279.02	269.64	254.65	239.72	225.09	215.41	220.11	227.66	242.82	260.23	273.00	(73)

6. Solar gains													
	Access factor Table 6d	Area m²	Solar flux W/m²		g specific data or Table 6b	FF specific data or Table 6c	Gains W						
NorthWest													
	0.77	x	9.67	x	11.28	x 0.9 x	0.45	x	0.80	=	27.22	(81)	
Solar gains in watts $\Sigma(74)m...(82)m$													
	27.22	55.41	99.83	163.94	220.37	234.94	219.78	175.21	121.64	67.71	34.25	22.23	(83)
Total gains - internal and solar (73)m + (83)m													
	307.87	334.43	369.47	418.59	460.09	460.02	435.19	395.32	349.30	310.53	294.48	295.23	(84)

7. Mean internal temperature (heating season)														
Temperature during heating periods in the living area from Table 9, Th1(°C)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
Utilisation factor for gains for living area n1,m (see Table 9a)														
	0.96	0.95	0.92	0.85	0.73	0.58	0.45	0.51	0.72	0.89	0.94	0.96	(86)	
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)														
	19.00	19.20	19.59	20.10	20.56	20.84	20.94	20.92	20.68	20.11	19.46	18.94	(87)	

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)													
	20.08	20.08	20.08	20.08	20.08	20.08	20.08	20.08	20.08	20.08	20.08	20.08	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.95	0.94	0.91	0.83	0.69	0.52	0.37	0.42	0.67	0.86	0.94	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	17.40	17.68	18.24	18.97	19.59	19.93	20.04	20.02	19.76	19.00	18.07	17.31	(90)
Living area fraction													
	Living area ÷ (4) =											0.45	(91)
Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2													
	18.13	18.37	18.85	19.49	20.03	20.34	20.45	20.43	20.18	19.50	18.70	18.05	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	18.13	18.37	18.85	19.49	20.03	20.34	20.45	20.43	20.18	19.50	18.70	18.05	(93)

8. Space heating requirement														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, ηm														
	0.94	0.92	0.89	0.81	0.69	0.54	0.41	0.46	0.67	0.85	0.92	0.94	(94)	
Useful gains, ηmGm, W (94)m x (84)m														
	288.80	308.21	327.12	339.11	317.42	247.56	176.63	181.03	235.56	263.05	270.29	278.63	(95)	
Monthly average external temperature from Table U1														
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)	
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]														
	669.75	652.45	598.21	512.62	403.32	278.14	186.51	195.15	294.48	431.12	561.94	670.92	(97)	
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m														
	283.43	231.33	201.69	124.93	63.91	0.00	0.00	0.00	0.00	125.04	209.99	291.86		
												$\Sigma(98)1...5, 10...12 =$	1532.18	(98)
Space heating requirement kWh/m²/year												(98) ÷ (4)	31.62	(99)

9a. Energy requirements - individual heating systems including micro-CHP														
Space heating														
Fraction of space heat from secondary/supplementary system (table 11)														
												0.00	(201)	
Fraction of space heat from main system(s)														
	1 - (201) =											1.00	(202)	
Fraction of space heat from main system 2														
												0.00	(202)	
Fraction of total space heat from main system 1														
	(202) x [1 - (203)] =											1.00	(204)	
Fraction of total space heat from main system 2														
	(202) x (203) =											0.00	(205)	
Efficiency of main system 1 (%)														
												100.00	(206)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating fuel (main system 1), kWh/month														
	283.43	231.33	201.69	124.93	63.91	0.00	0.00	0.00	0.00	125.04	209.99	291.86		
												$\Sigma(211)1...5, 10...12 =$	1532.18	(211)

Water heating														
Efficiency of water heater														
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)	
Water heating fuel, kWh/month														
	141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68		
												$\Sigma(219a)1...12 =$	1411.06	(219)

Annual totals													
Space heating fuel - main system 1													
												1532.18	
Water heating fuel													
												1411.06	

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside

39.42

(230a)

Total electricity for the above, kWh/year

39.42

(231)

Electricity for lighting (Appendix L)

225.47

(232)

Total delivered energy for all uses

(211)...(221) + (231) + (232)...(237b) =

3208.14

(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1532.18	x	13.19	x 0.01 =	202.09	(240)
Water heating	1411.06	x	13.19	x 0.01 =	186.12	(247)
Pumps and fans	39.42	x	13.19	x 0.01 =	5.20	(249)
Electricity for lighting	225.47	x	13.19	x 0.01 =	29.74	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	423.15	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.90	(257)
SAP value	73.47	
SAP rating (section 13)	73	(258)
SAP band	C	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1532.18	x	0.519	=	795.20	(261)
Water heating	1411.06	x	0.519	=	732.34	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1527.55	(265)
Pumps and fans	39.42	x	0.519	=	20.46	(267)
Electricity for lighting	225.47	x	0.519	=	117.02	(268)
Total CO ₂ , kg/year			(265)...(271) =		1665.02	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		34.37	(273)
EI value					76.12	
EI rating (section 14)					76	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1532.18	x	3.07	=	4703.80	(261)
Water heating	1411.06	x	3.07	=	4331.97	(264)
Space and water heating			(261) + (262) + (263) + (264) =		9035.77	(265)
Pumps and fans	39.42	x	3.07	=	121.02	(267)
Electricity for lighting	225.47	x	3.07	=	692.20	(268)
Primary energy kWh/year					9848.99	(272)
Dwelling primary energy rate kWh/m ² /year					203.28	(273)

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	18 MF SE x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	48.45	(1a)	x	2.70	(2a)	= 130.82 (3a)
Total floor area	48.45	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =	130.82	(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area			5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.25	(18)
Number of sides on which the dwelling is sheltered			3	(19)
Shelter factor		1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor		(18) x (20) =	0.19	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4

1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
------	------	------	------	------	------	------	------	------	------	------	------

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.22	0.23
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system

0.50 (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.35	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33
------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.35	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33
------	------	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.20	x 1.00	= 2.20		(26)						
Window			9.67	x 1.33	= 12.82		(27)						
External wall			30.65	x 0.17	= 5.21		(29a)						
Party wall			45.30	x 0.00	= 0.00		(32)						
Total area of external elements ΣA, m ²			42.52				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	20.23	(33)						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						6.61	(36)						
Total fabric heat loss					(33) + (36) =	26.84	(37)						
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	15.00	14.79	14.58	13.54	13.33	12.28	12.28	12.08	12.70	13.33	13.75	14.17	(38)
Heat transfer coefficient, W/K (37)m + (38)m	41.85	41.64	41.43	40.38	40.17	39.13	39.13	38.92	39.55	40.17	40.59	41.01	
	Average = Σ(39)1...12/12 =											40.33	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.86	0.86	0.86	0.83	0.83	0.81	0.81	0.80	0.82	0.83	0.84	0.85	
	Average = Σ(40)1...12/12 =											0.83	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.64	(42)											
Annual average hot water usage in litres per day Vd,average = (25 × N) + 36	73.26	(43)											
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	80.58	77.65	74.72	71.79	68.86	65.93	65.93	68.86	71.79	74.72	77.65	80.58	
	Σ(44)1...12 =											879.10	(44)
Energy content of hot water used = 4.18 × Vd,m × nm × Tm/3600 kWh/month (see Tables 1b, 1c 1d)	119.50	104.52	107.85	94.03	90.22	77.86	72.15	82.79	83.78	97.63	106.58	115.73	
	Σ(45)1...12 =											1152.64	(45)
Distribution loss 0.15 x (45)m	17.93	15.68	16.18	14.10	13.53	11.68	10.82	12.42	12.57	14.65	15.99	17.36	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00												(47)
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)	1.18												(48)
Temperature factor from Table 2b	0.60												(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71												(50)
Enter (50) or (54) in (55)	0.71												(55)
Water storage loss calculated for each month (55) x (41)m	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95	(57)
Primary circuit loss for each month from Table 3													

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
------	------	------	------	------	------	------	------	------	------	------	------	------	------

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68		
											Σ(64)1...12 =	1411.06	(64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

57.29	50.61	53.42	48.26	47.56	42.88	41.55	45.09	44.85	50.02	52.43	56.04	(65)
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5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	82.23	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.77	11.34	9.22	6.98	5.22	4.41	4.76	6.19	8.31	10.55	12.31	13.12	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	143.21	144.70	140.95	132.98	122.91	113.46	107.14	105.65	109.40	117.37	127.43	136.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	31.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	-65.78	(71)
Water heating gains (Table 5)	77.01	75.32	71.80	67.02	63.92	59.55	55.84	60.60	62.29	67.23	72.82	75.32	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	280.65	279.02	269.64	254.65	239.72	225.09	215.41	220.11	227.66	242.82	260.23	273.00	(73)

6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W							
SouthEast	0.77	x 9.67	x 36.79	x 0.9 x 0.45	x 0.80	= 88.76	(77)						
Solar gains in watts Σ(74)m...(82)m	88.76	151.20	206.88	256.33	287.11	285.03	274.80	251.84	224.00	167.11	106.32	75.96	(83)
Total gains - internal and solar (73)m + (83)m	369.42	430.22	476.52	510.98	526.83	510.12	490.21	471.95	451.66	409.92	366.55	348.97	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)												21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.89	0.84	0.75	0.62	0.47	0.34	0.37	0.55	0.77	0.90	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.55	19.83	20.18	20.55	20.81	20.95	20.98	20.98	20.90	20.58	20.02	19.51	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.20	20.20	20.21	20.22	20.23	20.25	20.25	20.25	20.24	20.23	20.22	20.21	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.92	0.88	0.82	0.72	0.58	0.42	0.29	0.31	0.50	0.74	0.88	0.93	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.25	18.66	19.15	19.68	20.01	20.20	20.24	20.24	20.14	19.72	18.95	18.21	(90)
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Living area fraction

Living area ÷ (4) = 0.45 (91)

Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2

18.84	19.19	19.61	20.08	20.37	20.54	20.58	20.57	20.49	20.11	19.44	18.80	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.84	19.19	19.61	20.08	20.37	20.54	20.58	20.57	20.49	20.11	19.44	18.80	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.91	0.87	0.81	0.71	0.59	0.44	0.31	0.34	0.52	0.74	0.87	0.92	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

334.83	372.34	384.65	364.76	310.92	222.49	153.15	159.30	234.42	301.83	317.22	319.91	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

608.56	595.01	543.30	451.37	348.43	232.32	155.59	162.47	252.60	382.13	500.87	598.93	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

203.65	149.63	118.03	62.36	27.91	0.00	0.00	0.00	0.00	59.75	132.23	207.59	
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Σ(98)1...5, 10...12 = 961.15 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 19.84 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

Fraction of total space heat from main system 1

(202) x [1 - (203)] = 1.00 (204)

Fraction of total space heat from main system 2

(202) x (203) = 0.00 (205)

Efficiency of main system 1 (%)

100.00 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

203.65	149.63	118.03	62.36	27.91	0.00	0.00	0.00	0.00	59.75	132.23	207.59	
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Σ(211)1...5, 10...12 = 961.15 (211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)
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Water heating fuel, kWh/month

141.45	124.34	129.80	115.27	112.17	99.10	94.09	104.74	105.02	119.58	127.82	137.68	
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Σ(219a)1...12 = 1411.06 (219)

Annual totals

Space heating fuel - main system 1

961.15

Water heating fuel

1411.06

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside

79.80 (230a)

Total electricity for the above, kWh/year

79.80 (231)

Electricity for lighting (Appendix L)

225.47 (232)

Total delivered energy for all uses

(211)...(221) + (231) + (232)...(237b) = 2677.49 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	961.15	x	13.19	x 0.01 =	126.78	(240)
Water heating	1411.06	x	13.19	x 0.01 =	186.12	(247)
Pumps and fans	79.80	x	13.19	x 0.01 =	10.53	(249)
Electricity for lighting	225.47	x	13.19	x 0.01 =	29.74	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	353.16	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.59	(257)
SAP value	77.86	
SAP rating (section 13)	78	(258)
SAP band	C	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	961.15	x	0.519	=	498.84	(261)
Water heating	1411.06	x	0.519	=	732.34	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1231.18	(265)
Pumps and fans	79.80	x	0.519	=	41.41	(267)
Electricity for lighting	225.47	x	0.519	=	117.02	(268)
Total CO ₂ , kg/year			(265)...(271) =		1389.61	(272)
Dwelling CO ₂ emission rate			(272) ÷ (4) =		28.68	(273)
EI value					80.07	
EI rating (section 14)					80	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	961.15	x	3.07	=	2950.73	(261)
Water heating	1411.06	x	3.07	=	4331.97	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7282.70	(265)
Pumps and fans	79.80	x	3.07	=	244.98	(267)
Electricity for lighting	225.47	x	3.07	=	692.20	(268)
Primary energy kWh/year					8219.88	(272)
Dwelling primary energy rate kWh/m2/year					169.66	(273)

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	12/08/2019
Address	2B Exp NW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	63.36 (1a) x	2.70 (2a) =	171.07 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) = 171.07 (5)	

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	0 x 10 =	0 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0 ÷ (5) =	0.00 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25 (18)
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Number of sides on which the dwelling is sheltered	3 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.78 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.19 (21)
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Infiltration rate modified for monthly wind speed:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

 (22)

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18
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 (22a)

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.25	0.24	0.24	0.21	0.21	0.18	0.18	0.19	0.21	0.22	0.23
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 (22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
---	---

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)
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c) whole house extract ventilation or positive input ventilation from outside	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
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 (24c)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
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 (25)

3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door	2.20	x	1.00	=	2.20		(26)
Window	13.04	x	1.33	=	17.29		(27)
Exposed floor	63.36	x	0.15	=	9.50		(28b)
External wall	45.84	x	0.17	=	7.79		(29a)
Party wall	45.30	x	0.00	=	0.00		(32)
Total area of external elements ΣA, m ²	124.44						(31)
Fabric heat loss, W/K = Σ(A x U)						(26)...(30) + (32) =	36.78 (33)
Heat capacity Cm = Σ(A x k)						(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m ² K							100.00 (35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							14.09 (36)
Total fabric heat loss						(33) + (36) =	50.88 (37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23

 (38)

Heat transfer coefficient, W/K (37)m + (38)m	79.10	79.10	79.10	79.10	79.10	79.10	79.10	79.10	79.10	79.10	79.10
Average = Σ(39)1...12/12 =	79.10 (39)										

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Average = Σ(40)1...12/12 =	1.25 (40)										

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00
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 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.07 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.48 (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83
Σ(44)1...12 =											1001.74 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)												
136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88	
										Σ(45)1...12 =	1313.44	(45)

Distribution loss 0.15 x (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78
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 (46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	151.00 (47)
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Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.18 (48)
Temperature factor from Table 2b	0.54 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.64 (50)
Enter (50) or (54) in (55)	0.64 (55)

Water storage loss calculated for each month (55) x (41)m	19.75	17.84	19.75	19.12	19.75	19.12	19.75	19.12	19.75	19.12	19.75	19.75
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 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	19.75	17.84	19.75	19.12	19.75	19.12	19.75	19.12	19.75	19.12	19.75	19.75
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 (57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
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Total heat required for water heating calculated for each month $0.85 \times (45)\text{m} + (46)\text{m} + (57)\text{m} + (59)\text{m} + (61)\text{m}$

179.19	157.95	165.92	148.78	145.83	130.35	125.23	137.35	137.09	154.27	163.07	174.89	(62)
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

179.19	157.95	165.92	148.78	145.83	130.35	125.23	137.35	137.09	154.27	163.07	174.89	
$\Sigma(64)1...12 =$											1819.91	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$

79.69	70.68	75.28	68.93	68.60	62.80	61.75	65.78	65.04	71.40	73.68	78.26	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

16.17	14.36	11.68	8.84	6.61	5.58	6.03	7.84	10.52	13.35	15.59	16.62	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	173.33	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	(71)
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Water heating gains (Table 5)

107.11	105.18	101.18	95.73	92.20	87.22	82.99	88.41	90.34	95.97	102.34	105.19	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

358.73	356.88	345.45	327.08	308.57	290.59	278.80	284.15	293.50	312.07	333.40	349.26	(73)
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6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W
NorthWest	0.77	13.04	11.28	0.45	0.80	36.71 (81)

Solar gains in watts $\Sigma(74)\text{m}... (82)\text{m}$

36.71	74.72	134.61	221.08	297.17	316.81	296.37	236.27	164.03	91.31	46.19	29.98	(83)
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Total gains - internal and solar (73)m + (83)m

395.44	431.60	480.07	548.15	605.74	607.40	575.18	520.42	457.53	403.37	379.59	379.24	(84)
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7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.96	0.95	0.93	0.88	0.78	0.65	0.52	0.58	0.77	0.91	0.95	0.97	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.96	0.95	0.92	0.85	0.74	0.57	0.41	0.47	0.71	0.88	0.94	0.96	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	(90)
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Living area fraction

Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2

20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.96	0.95	0.92	0.86	0.75	0.60	0.45	0.51	0.74	0.89	0.95	0.96	(94)

Useful gains, ηmGm, W (94)m x (84)m

379.99	409.74	442.83	472.01	455.46	363.90	261.43	266.18	336.60	359.78	359.33	365.84	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1263.47	1216.01	1089.44	899.59	678.09	448.69	290.48	306.30	488.24	765.11	1041.98	1271.38	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)\text{m} - (95)\text{m}] \times (41)\text{m}$

657.31	541.81	481.08	307.85	165.64	0.00	0.00	0.00	0.00	301.56	491.51	673.72		
$\Sigma(98)1...5, 10...12 =$											3620.48	(98)	
requirement kWh/m ² /year											(98) ÷ (4)	57.14	(99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)	0.00	(201)
Fraction of space heat from main system(s)	1 - (201) = 1.00	(202)
Fraction of space heat from main system 2	0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] = 1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) = 0.00	(205)
Efficiency of main system 1 (%)	332.56	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
197.65	162.92	144.66	92.57	49.81	0.00	0.00	0.00	0.00	90.68	147.79	202.58	
$\Sigma(211)1...5, 10...12 =$											1088.66	(211)

Water heating

Efficiency of water heater												
170.62	170.62	170.62	170.62	170.62	170.62	170.62	170.62	170.62	170.62	170.62	170.62	(217)
Water heating fuel, kWh/month												
105.02	92.58	97.24	87.20	85.47	76.40	73.39	80.50	80.35	90.42	95.58	102.50	
$\Sigma(219a)1...12 =$											1066.64	(219)

Annual totals

Space heating fuel - main system 1	1088.66	
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Water heating fuel				1066.64	
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive input from outside			54.26		(230a)
Total electricity for the above, kWh/year				54.26	(231)
Electricity for lighting (Appendix L)				285.50	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =		2495.06	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1088.66	x	13.19	x 0.01 =	143.59	(240)
Water heating	1066.64	x	13.19	x 0.01 =	140.69	(247)
Pumps and fans	54.26	x	13.19	x 0.01 =	7.16	(249)
Electricity for lighting	285.50	x	13.19	x 0.01 =	37.66	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	329.10	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)		1.28	(257)
SAP value		82.21	
SAP rating (section 13)		82	(258)
SAP band		B	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1088.66	x	0.519	=	565.01	(261)
Water heating	1066.64	x	0.519	=	553.59	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1118.60	(265)
Pumps and fans	54.26	x	0.519	=	28.16	(267)
Electricity for lighting	285.50	x	0.519	=	148.17	(268)
Total CO ₂ , kg/year				(265)...(271) =	1294.94	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	20.44	(273)
EI value					83.99	
EI rating (section 14)					84	(274)
EI band					B	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1088.66	x	3.07	=	3342.17	(261)
Water heating	1066.64	x	3.07	=	3274.60	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6616.77	(265)
Pumps and fans	54.26	x	3.07	=	166.59	(267)
Electricity for lighting	285.50	x	3.07	=	876.48	(268)
Primary energy kWh/year					7659.84	(272)
Dwelling primary energy rate kWh/m ² /year					120.89	(273)

DER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	12/08/2019
Address	2B MF NWSW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	63.36	(1a) x	2.70	(2a) =	171.07	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36					(4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 171.07					(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0	÷ (5) =	0.00	(8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)
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Number of sides on which the dwelling is sheltered	2	(19)
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Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.21	(21)
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Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	(22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)
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c) whole house extract ventilation or positive input ventilation from outside	0.52	0.52	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(24c)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.52	0.52	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K
Door			2.20	1.00	2.20		(26)
Window			18.42	1.33	24.42		(27)
External wall			40.90	0.17	6.95		(29a)
Party wall			22.21	0.00	0.00		(32)
Total area of external elements ΣA, m ²			61.52				(31)

Fabric heat loss, W/K = Σ(A × U)	(26)...(30) + (32) =	33.57	(33)
Heat capacity Cm = Σ(A × κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m ² K		100.00	(35)
Thermal bridges: Σ(L × Ψ) calculated using Appendix K		11.04	(36)
Total fabric heat loss	(33) + (36) =	44.62	(37)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29.41	29.11	28.81	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23

Heat transfer coefficient, W/K (37)m + (38)m	74.02	73.72	73.42	72.84	72.84	72.84	72.84	72.84	72.84	72.84	72.84
Average = Σ(39)1...12/12 =	73.06										

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.17	1.16	1.16	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Average = Σ(40)1...12/12 =	1.15										

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	31.00
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4. Water heating energy requirement

Assumed occupancy, N	2.07	(42)
Annual average hot water usage in litres per day Vd,average = (25 × N) + 36	83.48	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83
Σ(44)1...12 =											1001.74

Energy content of hot water used = 4.18 × Vd,m × nm × Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88
Σ(45)1...12 =	1313.44											

Distribution loss 0.15 × (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78
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Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00	(47)
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Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.18	(48)
Temperature factor from Table 2b	0.60	(49)
Energy lost from water storage (kWh/day) (48) × (49)	0.71	(50)
Enter (50) or (54) in (55)	0.71	(55)

Water storage loss calculated for each month (55) × (41)m	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95
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If the vessel contains dedicated solar storage or dedicated WWHRS (56)m × [(47) - Vs] ÷ (47), else (56)	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
------	------	------	------	------	------	------	------	------	------	------	------	------

Total heat required for water heating calculated for each month 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

158.12	138.92	144.85	128.39	124.76	109.96	104.16	116.29	116.70	133.20	142.68	153.83
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Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) (62)m + (63)m

158.12	138.92	144.85	128.39	124.76	109.96	104.16	116.29	116.70	133.20	142.68	153.83
Σ(64)1...12 =											1571.86

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

62.84	55.46	58.42	52.62	51.74	46.49	44.89	48.93	48.73	54.55	57.37	61.41
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

16.17	14.36	11.68	8.84	6.61	5.58	6.03	7.84	10.52	13.35	15.59	16.62
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	173.33
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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Losses e.g. evaporation (Table 5)

-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99
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Water heating gains (Table 5)

84.46	82.53	78.53	73.08	69.55	64.57	60.34	65.76	67.69	73.32	79.68	82.54
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

336.08	334.23	322.80	304.42	285.92	267.93	256.15	261.50	270.85	289.41	310.75	326.61
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	5.38	x	11.28	x 0.9	0.45	x	0.80	=	15.14	(81)
SouthWest	0.77	x	13.04	x	36.79	x 0.9	0.45	x	0.80	=	119.70	(79)

Solar gains in watts Σ(74)m...(82)m

134.84	234.72	334.51	436.87	509.77	515.08	492.85	437.09	369.74	263.01	162.43	114.80
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Total gains - internal and solar (73)m + (83)m

470.92	568.94	657.31	741.29	795.69	783.01	749.00	698.58	640.59	552.43	473.18	441.41
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00	(85)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.95	0.92	0.87	0.78	0.66	0.52	0.40	0.44	0.63	0.83	0.92	0.95

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	18.79	19.13	19.61	20.15	20.58	20.84	20.94	20.92	20.72	20.15	19.37	18.74	(87)		
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)															
	19.95	19.95	19.95	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	19.96	(88)		
Utilisation factor for gains for rest of dwelling n2,m															
	0.94	0.91	0.85	0.75	0.62	0.45	0.31	0.35	0.57	0.79	0.91	0.95	(89)		
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)															
	17.01	17.51	18.18	18.94	19.50	19.82	19.92	19.91	19.70	18.96	17.87	16.95	(90)		
Living area fraction										Living area ÷ (4) =				0.35	(91)
Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2															
	17.63	18.07	18.68	19.36	19.88	20.17	20.28	20.26	20.05	19.37	18.39	17.57	(92)		
Apply adjustment to the mean internal temperature from Table 4e where appropriate															
	17.63	18.07	18.68	19.36	19.88	20.17	20.28	20.26	20.05	19.37	18.39	17.57	(93)		

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, η_m													
	0.92	0.88	0.82	0.73	0.61	0.47	0.34	0.38	0.57	0.77	0.88	0.93	(94)
Useful gains, $\eta_m G_m$, W (94)m x (84)m													
	431.79	499.89	540.46	543.31	487.19	367.19	255.91	265.10	366.73	427.26	418.29	408.98	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, L_m , W [(39)m x [(93)m - (96)m]													
	986.71	971.22	894.45	761.96	595.60	406.01	267.96	281.35	433.71	639.06	822.70	974.03	(97)
Space heating requirement, kWh/month $0.024 \times [(97)m - (95)m] \times (41)m$													
	412.86	316.74	263.37	157.43	80.65	0.00	0.00	0.00	0.00	157.57	291.17	420.39	
	$\sum(98)1...5, 10...12 =$										2100.19	(98)	
Space heating requirement kWh/m ² /year	$(98) \div (4) =$										33.15	(99)	

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00

(201)

Fraction of space heat from main system(s)

1 - (201) =

1.00

(202)

Fraction of space heat from main system 2

0.00

(202)

Fraction of total space heat from main system 1

(202) x [1- (203)] =

1.00

(204)

Fraction of total space heat from main system 2

(202) x (203) =

0.00

(205)

Efficiency of main system 1 (%)

100.00

(206)

Jan

Feb

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Space heating fuel (main system 1), kWh/month

412.86

316.74

263.37

157.43

80.65

0.00

0.00

0.00

0.00

157.57

291.17

420.39

Σ(211)1...5, 10...12 =

2100.19

(211)

Water heating

Efficiency of water heater

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

(217)

Water heating fuel, kWh/month

158.12

138.92

144.85

128.39

124.76

109.96

104.16

116.29

116.70

133.20

142.68

153.83

Σ(219a)1...12 =

1571.86

(219)

Annual totals

Space heating fuel - main system 1

2100.19

Water heating fuel	1571.86
Electricity for pumps, fans and electric keep-hot (Table 4f)	
mechanical ventilation fans - balanced, extract or positive input from outside	54.26 (230a)
Total electricity for the above, kWh/year	54.26 (231)
Electricity for lighting (Appendix L)	285.50 (232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) = 4011.81 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2100.19	x	13.19	x 0.01 =	277.02	(240)
Water heating	1571.86	x	13.19	x 0.01 =	207.33	(247)
Pumps and fans	54.26	x	13.19	x 0.01 =	7.16	(249)
Electricity for lighting	285.50	x	13.19	x 0.01 =	37.66	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	529.16	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	2.05	(257)
SAP value	71.39	
SAP rating (section 13)	71	(258)
SAP band	C	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2100.19	x	0.519	=	1090.00	(261)
Water heating	1571.86	x	0.519	=	815.79	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1905.79	(265)
Pumps and fans	54.26	x	0.519	=	28.16	(267)
Electricity for lighting	285.50	x	0.519	=	148.17	(268)
Total CO ₂ , kg/year				(265)...(271) =	2082.13	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	32.86	(273)
EI value					74.25	
EI rating (section 14)					74	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2100.19	x	3.07	=	6447.58	(261)
Water heating	1571.86	x	3.07	=	4825.60	(264)
Space and water heating				(261) + (262) + (263) + (264) =	11273.18	(265)
Pumps and fans	54.26	x	3.07	=	166.59	(267)
Electricity for lighting	285.50	x	3.07	=	876.48	(268)
Primary energy kWh/year					12316.25	(272)
Dwelling primary energy rate kWh/m2/year					194.39	(273)

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	12/08/2019
Address	2B TF SESW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	63.36 (1a) x	2.70 (2a) =	171.07 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 63.36 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) = 171.07 (5)	

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	0 x 10 =	0 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0 ÷ (5) =	0.00 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25 (18)
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Number of sides on which the dwelling is sheltered	2 (19)
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Shelter factor	1 - [0.075 x (19)] = 0.85 (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = 0.21 (21)
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Infiltration rate modified for monthly wind speed:	
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70 (22)

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.93	1.00	1.08	1.13	1.18 (22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25 (22b)
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Calculate effective air change rate for the applicable case:	
If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A (23c)

c) whole house extract ventilation or positive input ventilation from outside	0.52	0.52	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50 (24c)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.52	0.52	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50 (25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x k, kJ/K
Door			2.20 x	1.00 =	2.20 (26)		
Window			18.42 x	1.33 =	24.42 (27)		
External wall			40.90 x	0.17 =	6.95 (29a)		
Party wall			22.21 x	0.00 =	0.00 (32)		
Roof			63.36 x	0.11 =	6.97 (30)		
Total area of external elements ΣA, m ²			124.88 (31)				

Fabric heat loss, W/K = Σ(A x U)	(26)...(30) + (32) =	40.54 (33)
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Heat capacity Cm = Σ(A x k)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
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Thermal mass parameter (TMP) in kJ/m ² K		100.00 (35)
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Thermal bridges: Σ(L x Ψ) calculated using Appendix K		14.57 (36)
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Total fabric heat loss	(33) + (36) =	55.11 (37)
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	29.41	29.11	28.81	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23	28.23 (38)

Heat transfer coefficient, W/K (37)m + (38)m	84.52	84.22	83.92	83.34	83.34	83.34	83.34	83.34	83.34	83.34	83.34	83.34
Average = Σ(39)1...12/12 =	83.56 (39)											

Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.33	1.33	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Average = Σ(40)1...12/12 =	1.32 (40)											

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00 (40)
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4. Water heating energy requirement

Assumed occupancy, N	2.07 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.48 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.83	88.49	85.15	81.81	78.47	75.13	75.13	78.47	81.81	85.15	88.49	91.83
Σ(44)1...12 =	1001.74 (44)											

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.18	119.10	122.90	107.15	102.81	88.72	82.21	94.34	95.46	111.25	121.44	131.88
Σ(45)1...12 =	1313.44 (45)											

Distribution loss 0.15 x (45)m	20.43	17.86	18.44	16.07	15.42	13.31	12.33	14.15	14.32	16.69	18.22	19.78 (46)
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Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00 (47)											
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Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	1.18 (48)
Temperature factor from Table 2b	0.60 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71 (50)
Enter (50) or (54) in (55)	0.71 (55)

Water storage loss calculated for each month (55) x (41)m	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95 (56)
---	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	------------------------------------	---

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95 (57)
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Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
------	------	------	------	------	------	------	------	------	------	------	------	------	------

Total heat required for water heating calculated for each month $0.85 \times (45)\text{m} + (46)\text{m} + (57)\text{m} + (59)\text{m} + (61)\text{m}$

158.12	138.92	144.85	128.39	124.76	109.96	104.16	116.29	116.70	133.20	142.68	153.83	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
------	------	------	------	------	------	------	------	------	------	------	------	------	------

Output from water heater for each month (kWh/month) $(62)\text{m} + (63)\text{m}$

158.12	138.92	144.85	128.39	124.76	109.96	104.16	116.29	116.70	133.20	142.68	153.83		
											$\Sigma(64)1...12 =$	1571.86	(64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)\text{m} + (61)\text{m}] + 0.8 \times [(46)\text{m} + (57)\text{m} + (59)\text{m}]$

62.84	55.46	58.42	52.62	51.74	46.49	44.89	48.93	48.73	54.55	57.37	61.41	(65)
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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	103.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

16.17	14.36	11.68	8.84	6.61	5.58	6.03	7.84	10.52	13.35	15.59	16.62	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

181.33	183.22	178.47	168.38	155.64	143.66	135.66	133.78	138.52	148.61	161.36	173.33	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
------	------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	-82.99	(71)
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Water heating gains (Table 5)

84.46	82.53	78.53	73.08	69.55	64.57	60.34	65.76	67.69	73.32	79.68	82.54	(72)
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Total internal gains $(66)\text{m} + (67)\text{m} + (68)\text{m} + (69)\text{m} + (70)\text{m} + (71)\text{m} + (72)\text{m}$

336.08	334.23	322.80	304.42	285.92	267.93	256.15	261.50	270.85	289.41	310.75	326.61	(73)
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6. Solar gains

	Access factor Table 6d		Area m ²		Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W		
SouthEast	0.77	x	5.38	x	36.79	x 0.9 x	0.45	x	0.80	=	49.38	(77)	
SouthWest	0.77	x	13.04	x	36.79	x 0.9 x	0.45	x	0.80	=	119.70	(79)	
Solar gains in watts $\Sigma(74)\text{m}...(82)\text{m}$													
	169.08	288.01	394.07	488.27	546.90	542.95	523.46	479.72	426.69	318.31	202.52	144.70	(83)
Total gains - internal and solar (73)m + (83)m													
	505.16	622.24	716.87	792.70	832.82	810.88	779.61	741.22	697.54	607.73	513.27	471.31	(84)

7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------	------

Utilisation factor for gains for living area n1,m (see Table 9a)

0.94	0.91	0.86	0.79	0.68	0.55	0.43	0.46	0.64	0.82	0.92	0.95	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

18.52	18.90	19.41	19.97	20.44	20.77	20.91	20.89	20.65	20.02	19.16	18.46	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.81	19.82	19.82	19.83	19.83	19.83	19.83	19.83	19.83	19.83	19.83	19.83	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.93	0.90	0.84	0.75	0.63	0.47	0.33	0.36	0.56	0.78	0.90	0.94	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

16.56	17.10	17.82	18.61	19.23	19.63	19.77	19.76	19.50	18.69	17.49	16.48	(90)
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Living area fraction

Living area ÷ (4) =

0.35

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.24	17.73	18.37	19.08	19.66	20.03	20.17	20.15	19.90	19.15	18.08	17.17	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.24	17.73	18.37	19.08	19.66	20.03	20.17	20.15	19.90	19.15	18.08	17.17	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.91	0.87	0.81	0.73	0.62	0.49	0.36	0.39	0.57	0.76	0.87	0.92	(94)

Useful gains, ηmGm, W (94)m x (84)m

458.83	539.01	581.25	578.86	518.58	395.41	278.77	288.79	397.52	462.14	448.16	433.03	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1093.92	1080.65	996.33	848.63	663.17	452.18	297.57	312.67	483.66	712.62	914.84	1080.93	(97)
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Space heating requirement, kWh/month $0.024 \times [(97)\text{m} - (95)\text{m}] \times (41)\text{m}$

472.51	363.98	308.82	194.24	107.57	0.00	0.00	0.00	0.00	186.36	336.01	482.04	
$\Sigma(98)1...5, 10...12 =$											2451.54	(98)

Space heating requirement kWh/m²/year

(98) ÷ (4)

38.69

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)			0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =		1.00	(202)
Fraction of space heat from main system 2			0.00	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] =		1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =		0.00	(205)
Efficiency of main system 1 (%)			100.00	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month											
472.51	363.98	308.82	194.24	107.57	0.00	0.00	0.00	0.00	186.36	336.01	482.04
$\sum(211)_{1...5, 10...12} =$										2451.54	(211)

Water heating

Efficiency of water heater	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)
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Water heating fuel, kWh/month

158.12	138.92	144.85	128.39	124.76	109.96	104.16	116.29	116.70	133.20	142.68	153.83		
											$\Sigma(219a)1...12 =$	1571.86	(219)

Annual totals

Space heating fuel - main system 1		2451.54	
Water heating fuel		1571.86	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	54.26		(230a)
Total electricity for the above, kWh/year		54.26	(231)
Electricity for lighting (Appendix L)		285.50	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4363.15	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2451.54	x	13.19	x 0.01 =	323.36	(240)
Water heating	1571.86	x	13.19	x 0.01 =	207.33	(247)
Pumps and fans	54.26	x	13.19	x 0.01 =	7.16	(249)
Electricity for lighting	285.50	x	13.19	x 0.01 =	37.66	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	575.50	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	2.23	(257)
SAP value	68.88	
SAP rating (section 13)	69	(258)
SAP band	C	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	2451.54	x	0.519	=	1272.35	(261)
Water heating	1571.86	x	0.519	=	815.79	(264)
Space and water heating			(261) + (262) + (263) + (264) =		2088.14	(265)
Pumps and fans	54.26	x	0.519	=	28.16	(267)
Electricity for lighting	285.50	x	0.519	=	148.17	(268)
Total CO ₂ , kg/year				(265)...(271) =	2264.48	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	35.74	(273)
EI value					72.00	
EI rating (section 14)					72	(274)
EI band					C	

13a. Primary energy - individual heating systems including micro-CHP

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2451.54	x	3.07	=	7526.21	(261)
Water heating	1571.86	x	3.07	=	4825.60	(264)
Space and water heating			(261) + (262) + (263) + (264) =		12351.81	(265)
Pumps and fans	54.26	x	3.07	=	166.59	(267)
Electricity for lighting	285.50	x	3.07	=	876.48	(268)
Primary energy kWh/year					13394.88	(272)
Dwelling primary energy rate kWh/m ² /year					211.41	(273)

DER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Jonathan Peck	Assessor number	10160
Client		Last modified	08/08/2019
Address	3B TF SESW x x, Reading, RG1		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)	
Lowest occupied	83.79	(1a)	x	2.70	(2a)	= 226.23 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 83.79	(4)				
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =	226.23	(5)

2. Ventilation rate

			m ³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0	÷ (5) = 0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q ₅₀ , expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.21	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)

Wind factor (22)m ÷ 4

1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

0.27	0.27	0.26	0.23	0.23	0.20	0.20	0.20	0.21	0.23	0.24	0.25	(22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system 0.50 (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h 79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(24a)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.37	0.37	0.36	0.33	0.33	0.30	0.30	0.30	0.31	0.33	0.34	0.35	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	κ-value, kJ/m ² .K	A x κ, kJ/K						
Door			2.20	x 1.00	= 2.20			(26)					
Window			18.42	x 1.33	= 24.42			(27)					
External wall			77.03	x 0.17	= 13.10			(29a)					
Party wall			27.18	x 0.00	= 0.00			(32)					
Roof			83.79	x 0.11	= 9.22			(30)					
Total area of external elements ΣA, m ²			181.44					(31)					
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	48.93		(33)					
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A		(34)					
Thermal mass parameter (TMP) in kJ/m ² K						100.00		(35)					
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						16.72		(36)					
Total fabric heat loss					(33) + (36) =	65.66		(37)					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	27.73	27.33	26.94	24.95	24.56	22.57	22.57	22.18	23.37	24.56	25.35	26.14	(38)
Heat transfer coefficient, W/K (37)m + (38)m	93.39	92.99	92.59	90.61	90.21	88.23	88.23	87.83	89.02	90.21	91.01	91.80	
	Average = Σ(39)1...12/12 =											90.51	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.11	1.11	1.11	1.08	1.08	1.05	1.05	1.05	1.06	1.08	1.09	1.10	
	Average = Σ(40)1...12/12 =											1.08	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.53												(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.31												(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	103.74	99.97	96.19	92.42	88.65	84.88	84.88	88.65	92.42	96.19	99.97	103.74	
	Σ(44)1...12 =											1131.69	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	153.84	134.55	138.84	121.05	116.15	100.23	92.87	106.58	107.85	125.69	137.20	148.99	
	Σ(45)1...12 =											1483.83	(45)
Distribution loss 0.15 x (45)m	23.08	20.18	20.83	18.16	17.42	15.03	13.93	15.99	16.18	18.85	20.58	22.35	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	145.00												(47)
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)	1.18												(48)
Temperature factor from Table 2b	0.60												(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.71												(50)
Enter (50) or (54) in (55)	0.71												(55)
Water storage loss calculated for each month (55) x (41)m	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	21.95	19.82	21.95	21.24	21.95	21.24	21.95	21.95	21.24	21.95	21.24	21.95	(57)

Primary circuit loss for each month from Table 3

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)	
Combi loss for each month from Table 3a, 3b or 3c														
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)	
Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$														
	175.79	154.37	160.79	142.29	138.10	121.47	114.82	128.52	129.09	147.63	158.44	170.93	(62)	
Solar DHW input calculated using Appendix G or Appendix H														
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)	
Output from water heater for each month (kWh/month) $(62)m + (63)m$														
	175.79	154.37	160.79	142.29	138.10	121.47	114.82	128.52	129.09	147.63	158.44	170.93		
											$\Sigma(64)1...12 =$		1742.25	(64)
Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$														
	68.71	60.60	63.72	57.24	56.18	50.32	48.44	52.99	52.85	59.35	62.61	67.10	(65)	

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	126.54	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.25	17.99	14.63	11.08	8.28	6.99	7.55	9.82	13.18	16.73	19.53	20.82	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	227.18	229.54	223.60	210.95	194.98	179.98	169.96	167.60	173.54	186.19	202.15	217.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	35.65	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	-101.23	(71)
Water heating gains (Table 5)	92.35	90.17	85.65	79.50	75.51	69.89	65.11	71.23	73.40	79.77	86.96	90.18	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	400.75	398.66	384.84	362.49	339.73	317.82	303.58	309.61	321.08	343.65	369.60	389.12	(73)

6. Solar gains

	Access factor Table 6d		Area m ²	Solar flux W/m ²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77		x 5.38	x 36.79	x 0.9 x	0.45	x 0.80	=	49.38	(77)	
SouthWest	0.77		x 13.04	x 36.79	x 0.9 x	0.45	x 0.80	=	119.70	(79)	
Solar gains in watts Σ(74)m...(82)m											
169.08 288.01 394.07 488.27 546.90 542.95 523.46 479.72 426.69 318.31 202.52 144.70 (83)											
Total gains - internal and solar (73)m + (83)m											
569.83 686.67 778.91 850.76 886.64 860.77 827.04 789.33 747.78 661.96 572.12 533.82 (84)											

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)	21.00											(85)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.93	0.89	0.82	0.71	0.57	0.44	0.47	0.66	0.84	0.93	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.81	19.14	19.59	20.12	20.54	20.83	20.94	20.93	20.73	20.17	19.40	18.76	(87)	
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.99	19.99	20.00	20.02	20.02	20.04	20.04	20.04	20.03	20.02	20.01	20.00	(88)	
Utilisation factor for gains for rest of dwelling n2,m	0.95	0.92	0.87	0.79	0.67	0.50	0.35	0.38	0.60	0.81	0.92	0.96	(89)	
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.07	17.54	18.18	18.94	19.51	19.89	20.00	19.99	19.77	19.03	17.94	17.01	(90)	
Living area fraction	Living area ÷ (4) =												0.29	(91)
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.56	18.00	18.59	19.28	19.81	20.16	20.27	20.26	20.04	19.35	18.36	17.51	(92)	
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.56	18.00	18.59	19.28	19.81	20.16	20.27	20.26	20.04	19.35	18.36	17.51	(93)	

8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, η_m	0.93	0.89	0.84	0.77	0.66	0.51	0.37	0.40	0.60	0.79	0.90	0.94
Useful gains, $\eta_m G_m$, W (94)m x (84)m	528.46	612.77	656.92	651.77	583.00	439.43	308.40	319.43	446.55	524.24	513.09	499.83
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
Heat loss rate for mean internal temperature, L_m , W [(39)m x [(93)m - (96)m]	1238.70	1218.28	1119.06	940.38	731.34	490.19	323.66	338.87	529.03	789.55	1024.80	1222.04
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	528.42	406.90	343.83	207.80	110.37	0.00	0.00	0.00	0.00	197.39	368.43	537.32
	$\Sigma(98)1...5, 10...12 =$										2700.47	
Space heating requirement kWh/m ² /year	$(98) \div (4)$										32.23	

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00

(201)

Fraction of space heat from main system(s)

$1 - (201) =$

1.00

(202)

Fraction of space heat from main system 2

0.00

(202)

Fraction of total space heat from main system 1

$(202) \times [1 - (203)] =$

1.00

(204)

Fraction of total space heat from main system 2

$(202) \times (203) =$

0.00

(205)

Efficiency of main system 1 (%)

100.00

(206)

Jan

Feb

Mar

Apr

May

Jun

Jul

Aug

Sep

Oct

Nov

Dec

Space heating fuel (main system 1), kWh/month

528.42

406.90

343.83

207.80

110.37

0.00

0.00

0.00

0.00

197.39

368.43

537.32

$\Sigma(211)1...5, 10...12 =$

2700.47

(211)

Water heating

Efficiency of water heater

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

100.00

(217)

Water heating fuel, kWh/month

175.79

154.37

160.79

142.29

138.10

121.47

114.82

128.52

129.09

147.63

158.44

170.93

$\Sigma(219a)1...12 =$

1742.25

(219)

Annual totals

Space heating fuel - main system 1		2700.47	
Water heating fuel		1742.25	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	148.35		(230a)
Total electricity for the above, kWh/year		148.35	(231)
Electricity for lighting (Appendix L)		357.68	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4948.75	(238)

10a. Fuel costs - individual heating systems including micro-CHP						
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2700.47	x	13.19	x 0.01 =	356.19	(240)
Water heating	1742.25	x	13.19	x 0.01 =	229.80	(247)
Pumps and fans	148.35	x	13.19	x 0.01 =	19.57	(249)
Electricity for lighting	357.68	x	13.19	x 0.01 =	47.18	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	652.74	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	2.13	(257)
SAP value	70.31	
SAP rating (section 13)	70	(258)
SAP band	C	

12a. CO ₂ emissions - individual heating systems including micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year
Space heating - main system 1	2700.47	x	0.519	=	1401.54 (261)
Water heating	1742.25	x	0.519	=	904.23 (264)
Space and water heating			(261) + (262) + (263) + (264) =		2305.77 (265)
Pumps and fans	148.35	x	0.519	=	76.99 (267)
Electricity for lighting	357.68	x	0.519	=	185.63 (268)
Total CO ₂ , kg/year				(265)...(271) =	2568.40 (272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	30.65 (273)
EI value					73.28
EI rating (section 14)					73 (274)
EI band					C

13a. Primary energy - individual heating systems including micro-CHP						
	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2700.47	x	3.07	=	8290.44	(261)
Water heating	1742.25	x	3.07	=	5348.70	(264)
Space and water heating			(261) + (262) + (263) + (264) =		13639.14	(265)
Pumps and fans	148.35	x	3.07	=	455.44	(267)
Electricity for lighting	357.68	x	3.07	=	1098.07	(268)
Primary energy kWh/year					15192.65	(272)
Dwelling primary energy rate kWh/m2/year					181.32	(273)

Appendix D

**SBEM BRUKL Reports for
Representative Non-Residential
Spaces (*Taken from MLM Energy
Statement*)**

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:03:11 2016

Administrative information

Building Details

Address: Cafe/Restaurant, East Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	95
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	95
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	86.5
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Cafe) - Eat & Drink_W_8
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Cafe) - Eat & Drink_G_9
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Main Multipoint BF

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.76	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - WC		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - WC	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
	Standard value	60	60	22
0 Ground (Cafe) - Eat & Drink	-	90	90	349

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
0 Ground (Cafe) - Food Prep		-	90	-	156
0 Ground (Cafe) - WC		-	90	-	27

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?
0 Ground (Cafe) - Eat & Drink	NO (-10.2%)	NO
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - WC	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]	156.9	156.9
External area [m ²]	256.1	256.1
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	5
Average conductance [W/K]	127.39	104.3
Average U-value [W/m ² K]	0.5	0.41
Alpha value* [%]	17.23	17.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	83.69	76.62
Cooling	21.47	31.93
Auxiliary	22.79	14.1
Lighting	29.14	56.39
Hot water	140.19	123.41
Equipment*	126.49	126.49
TOTAL **	297.29	302.44

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	624.3	639.7
Primary energy* [kWh/m ²]	498.48	550.58
Total emissions [kg/m ²]	86.5	95

* 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	277.8	346.5	83.7	21.5	22.8	0.92	4.48	0.94	6
Notional	225.9	413.8	76.6	31.9	14.1	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Cafe) - Eat & Drink_W_8
Floor	0.2	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.15	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Cafe) - Eat & Drink_G_9
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:17:40 2016

Administrative information

Building Details

Address: Cafe, West Block, Kenavon Drive, READING,

Owner Details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	95
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	95
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	86.4
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Cafe) - Eat & Drink_W_6
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Food Prep_S_3
Roof	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Cafe) - Eat & Drink_G_7
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Main Multipoint BF

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.76	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - WCs		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
	Standard value	60	60	22
0 Ground (Cafe) - Food Prep	-	90	-	156

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
0 Ground (Cafe) - Eat & Drink		-	90	90	347
0 Ground (Cafe) - WCs		-	90	-	27

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?
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - Eat & Drink	NO (-7.7%)	NO
0 Ground (Cafe) - WCs	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]	156.4	156.4
External area [m ²]	255.3	255.3
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	5
Average conductance [W/K]	127.13	103.95
Average U-value [W/m ² K]	0.5	0.41
Alpha value* [%]	17.23	17.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	82.37	75.62
Cooling	21.81	32.23
Auxiliary	22.86	14.14
Lighting	29.12	56.37
Hot water	140.14	123.36
Equipment*	126.52	126.52
TOTAL **	296.3	301.71

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	625.52	640.69
Primary energy* [kWh/m ²]	498.01	550.27
Total emissions [kg/m ²]	86.4	95

* 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	273.4	352.1	82.4	21.8	22.9	0.92	4.48	0.94	6
Notional	222.9	417.7	75.6	32.2	14.1	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Cafe) - Eat & Drink_W_6
Floor	0.2	0.13	0 Ground (Cafe) - Food Prep_S_3
Roof	0.15	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Cafe) - Eat & Drink_G_7
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 11:08:32 2016

Administrative information

Building Details

Address: Cafe/Restaurant, Middle Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	89.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	89.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	78.5
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	1 First (Cafe) - Eat & Drink_W_6
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	1 First (Cafe) - Eat & Drink_G_7
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Gas-fired condensing water heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0.015
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
1 First (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - WCs		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
1 First (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
1 First (Cafe) - Eat & Drink	-	90	90	810

General lighting and display lighting		Luminous efficacy [lm/W]		
Zone name		Luminaire	Lamp	Display lamp
	Standard value	60	60	22
0 Ground (Cafe) - Eat & Drink		-	90	90
0 Ground (Cafe) - Food Prep		-	90	-
0 Ground (Cafe) - WCs		-	90	-
				General lighting [W]
				649
				572
				69

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?
1 First (Cafe) - Eat & Drink	NO (-55.3%)	NO
0 Ground (Cafe) - Eat & Drink	NO (-12.9%)	NO
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - WCs	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]	657.8	657.8
External area [m ²]	641.5	641.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	378.7	321.19
Average U-value [W/m ² K]	0.59	0.5
Alpha value* [%]	12.49	15.4

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	62.87	63.63
Cooling	18.08	31.87
Auxiliary	23.72	14.64
Lighting	27.84	50.42
Hot water	133.14	123.02
Equipment*	127.18	127.18
TOTAL **	265.66	283.58

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	500.56	600.6
Primary energy* [kWh/m ²]	452.96	517.82
Total emissions [kg/m ²]	78.5	89.4

* 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] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	208.7	291.9	62.9	18.1	23.7	0.92	4.48	0.94	6
Notional	187.6	413	63.6	31.9	14.6	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	1 First (Cafe) - Eat & Drink_W_6
Floor	0.2	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.6	1 First (Cafe) - Eat & Drink_G_7
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 10:34:59 2016

Administrative information

Building Details

Address: Nursery, Middle Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	16.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	16.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	16.2
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Nursery) - Teaching_W_9
Floor	0.25	0.13	0.13	0 Ground (Nursery) - Teaching_S_3
Roof	0.25	0.13	0.13	0 Ground (Nursery) - Teaching_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Nursery) - Teaching_G_10
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- DHW instantaneous electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	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		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
0 Ground (Nursery) - Teaching	-	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Nursery) - WCs	-	-	0.5	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Nursery) - Teaching	YES
0 Ground (Nursery) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
0 Ground (Nursery) - Teaching	90	-	-	1287
0 Ground (Nursery) - WCs	-	90	-	48

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?
0 Ground (Nursery) - Teaching	NO (-39.7%)	NO
0 Ground (Nursery) - WCs	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]	280.4	280.4
External area [m ²]	572.7	572.7
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	165.21	256.35
Average U-value [W/m ² K]	0.29	0.45
Alpha value* [%]	19.19	15.99

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
100	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	12.92	19.33
Cooling	5.28	6.61
Auxiliary	0.54	0.65
Lighting	7.28	8.1
Hot water	12.72	14.72
Equipment*	14.09	14.09
TOTAL **	38.74	49.41

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	128.13	142.72
Primary energy* [kWh/m ²]	95.04	85.74
Total emissions [kg/m ²]	16.2	16.6

* 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	42.9	85.2	12.9	5.3	0.5	0.92	4.48	0.94	6
Notional	57	85.7	19.3	6.6	0.6	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Nursery) - Teaching_W_9
Floor	0.2	0.13	0 Ground (Nursery) - Teaching_S_3
Roof	0.15	0.13	0 Ground (Nursery) - Teaching_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Nursery) - Teaching_G_10
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:24:09 2016

Administrative information

Building Details

Address: Retail, West Block, Kenavon Drive, READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	40.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	40.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	29.1
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Retail) - Sales_W_10
Floor	0.25	0.13	0.13	0 Ground (Retail) - Sales_S_3
Roof	0.25	0.13	0.13	0 Ground (Retail) - Sales_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Retail) - Sales_G_11
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- DHW instantaneous electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	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		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
0 Ground (Retail) - Sales	-	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Retail) - WC	-	-	0.5	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Retail) - Sales	YES
0 Ground (Retail) - WC	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
0 Ground (Retail) - Sales	-	90	90	3979
0 Ground (Retail) - WC	-	90	-	36

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?
0 Ground (Retail) - Sales	NO (-6.8%)	NO
0 Ground (Retail) - WC	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]	406.9	406.9
External area [m ²]	640.3	640.3
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	189.59	261.69
Average U-value [W/m ² K]	0.3	0.41
Alpha value* [%]	14.67	13.12

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	10.73	13.64
Cooling	11.91	17.05
Auxiliary	0.17	0.2
Lighting	37.87	56.3
Hot water	1.68	1.94
Equipment*	20.25	20.25
TOTAL **	62.35	89.13

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	227.88	261.16
Primary energy* [kWh/m ²]	171.58	238.93
Total emissions [kg/m ²]	29.1	40.8

* 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] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	35.6	192.3	10.7	11.9	0.2	0.92	4.48	0.94	6
Notional	40.2	221	13.6	17	0.2	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Retail) - Sales_W_10
Floor	0.2	0.13	0 Ground (Retail) - Sales_S_3
Roof	0.15	0.13	0 Ground (Retail) - Sales_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Retail) - Sales_G_11
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:03:11 2016

Administrative information

Building Details

Address: Cafe/Restaurant, East Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	95
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	95
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	86.5
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Cafe) - Eat & Drink_W_8
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Cafe) - Eat & Drink_G_9
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Main Multipoint BF

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.76	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - WC		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - WC	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
	Standard value	60	60	22
0 Ground (Cafe) - Eat & Drink	-	90	90	349

General lighting and display lighting		Luminous efficacy [lm/W]		
Zone name		Luminaire	Lamp	Display lamp
	Standard value	60	60	22
0 Ground (Cafe) - Food Prep		-	90	-
0 Ground (Cafe) - WC		-	90	-
				General lighting [W]
				156
				27

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?
0 Ground (Cafe) - Eat & Drink	NO (-10.2%)	NO
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - WC	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]	156.9	156.9
External area [m ²]	256.1	256.1
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	5
Average conductance [W/K]	127.39	104.3
Average U-value [W/m ² K]	0.5	0.41
Alpha value* [%]	17.23	17.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	83.69	76.62
Cooling	21.47	31.93
Auxiliary	22.79	14.1
Lighting	29.14	56.39
Hot water	140.19	123.41
Equipment*	126.49	126.49
TOTAL **	297.29	302.44

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	624.3	639.7
Primary energy* [kWh/m ²]	498.48	550.58
Total emissions [kg/m ²]	86.5	95

* 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	277.8	346.5	83.7	21.5	22.8	0.92	4.48	0.94	6
Notional	225.9	413.8	76.6	31.9	14.1	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Cafe) - Eat & Drink_W_8
Floor	0.2	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.15	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Cafe) - Eat & Drink_G_9
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:17:40 2016

Administrative information

Building Details

Address: Cafe, West Block, Kenavon Drive, READING,

Owner Details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	95
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	95
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	86.4
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Cafe) - Eat & Drink_W_6
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Food Prep_S_3
Roof	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Cafe) - Eat & Drink_G_7
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Main Multipoint BF

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.76	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - WCs		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
	Standard value	60	60	22
0 Ground (Cafe) - Food Prep	-	90	-	156

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
0 Ground (Cafe) - Eat & Drink		-	90	90	347
0 Ground (Cafe) - WCs		-	90	-	27

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?
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - Eat & Drink	NO (-7.7%)	NO
0 Ground (Cafe) - WCs	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]	156.4	156.4
External area [m ²]	255.3	255.3
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	5
Average conductance [W/K]	127.13	103.95
Average U-value [W/m ² K]	0.5	0.41
Alpha value* [%]	17.23	17.31

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	82.37	75.62
Cooling	21.81	32.23
Auxiliary	22.86	14.14
Lighting	29.12	56.37
Hot water	140.14	123.36
Equipment*	126.52	126.52
TOTAL **	296.3	301.71

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	625.52	640.69
Primary energy* [kWh/m ²]	498.01	550.27
Total emissions [kg/m ²]	86.4	95

* 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	273.4	352.1	82.4	21.8	22.9	0.92	4.48	0.94	6
Notional	222.9	417.7	75.6	32.2	14.1	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Cafe) - Eat & Drink_W_6
Floor	0.2	0.13	0 Ground (Cafe) - Food Prep_S_3
Roof	0.15	0.13	0 Ground (Cafe) - Eat & Drink_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Cafe) - Eat & Drink_G_7
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 11:08:32 2016

Administrative information

Building Details

Address: Cafe/Restaurant, Middle Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	89.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	89.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	78.5
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	1 First (Cafe) - Eat & Drink_W_6
Floor	0.25	0.13	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	1 First (Cafe) - Eat & Drink_G_7
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- Gas-fired condensing water heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0.015
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
1 First (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Eat & Drink		-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Cafe) - Food Prep		-	-	-	-	-	-	-	-	1	-	N/A
0 Ground (Cafe) - WCs		-	-	0.5	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
1 First (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Eat & Drink	YES
0 Ground (Cafe) - Food Prep	YES
0 Ground (Cafe) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
1 First (Cafe) - Eat & Drink	-	90	90	810

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
0 Ground (Cafe) - Eat & Drink		-	90	90	649
0 Ground (Cafe) - Food Prep		-	90	-	572
0 Ground (Cafe) - WCs		-	90	-	69

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?
1 First (Cafe) - Eat & Drink	NO (-55.3%)	NO
0 Ground (Cafe) - Eat & Drink	NO (-12.9%)	NO
0 Ground (Cafe) - Food Prep	N/A	N/A
0 Ground (Cafe) - WCs	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]	657.8	657.8
External area [m ²]	641.5	641.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	378.7	321.19
Average U-value [W/m ² K]	0.59	0.5
Alpha value* [%]	12.49	15.4

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	62.87	63.63
Cooling	18.08	31.87
Auxiliary	23.72	14.64
Lighting	27.84	50.42
Hot water	133.14	123.02
Equipment*	127.18	127.18
TOTAL **	265.66	283.58

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	500.56	600.6
Primary energy* [kWh/m ²]	452.96	517.82
Total emissions [kg/m ²]	78.5	89.4

* 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] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	208.7	291.9	62.9	18.1	23.7	0.92	4.48	0.94	6
Notional	187.6	413	63.6	31.9	14.6	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	1 First (Cafe) - Eat & Drink_W_6
Floor	0.2	0.13	0 Ground (Cafe) - Eat & Drink_S_3
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.6	1 First (Cafe) - Eat & Drink_G_7
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 10:34:59 2016

Administrative information

Building Details

Address: Nursery, Middle Block, Kenavon Drive,
READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	16.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	16.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	16.2
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Nursery) - Teaching_W_9
Floor	0.25	0.13	0.13	0 Ground (Nursery) - Teaching_S_3
Roof	0.25	0.13	0.13	0 Ground (Nursery) - Teaching_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Nursery) - Teaching_G_10
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- DHW instantaneous electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	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		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
0 Ground (Nursery) - Teaching	-	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Nursery) - WCs	-	-	0.5	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Nursery) - Teaching	YES
0 Ground (Nursery) - WCs	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
0 Ground (Nursery) - Teaching	90	-	-	1287
0 Ground (Nursery) - WCs	-	90	-	48

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?
0 Ground (Nursery) - Teaching	NO (-39.7%)	NO
0 Ground (Nursery) - WCs	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]	280.4	280.4
External area [m ²]	572.7	572.7
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	165.21	256.35
Average U-value [W/m ² K]	0.29	0.45
Alpha value* [%]	19.19	15.99

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
100	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	12.92	19.33
Cooling	5.28	6.61
Auxiliary	0.54	0.65
Lighting	7.28	8.1
Hot water	12.72	14.72
Equipment*	14.09	14.09
TOTAL **	38.74	49.41

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	128.13	142.72
Primary energy* [kWh/m ²]	95.04	85.74
Total emissions [kg/m ²]	16.2	16.6

* 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	42.9	85.2	12.9	5.3	0.5	0.92	4.48	0.94	6
Notional	57	85.7	19.3	6.6	0.6	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	0 Ground (Nursery) - Teaching_W_9
Floor	0.2	0.13	0 Ground (Nursery) - Teaching_S_3
Roof	0.15	0.13	0 Ground (Nursery) - Teaching_R_5
Windows, roof windows, and rooflights	1.5	1.6	0 Ground (Nursery) - Teaching_G_10
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)]			
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Project name

Shell and Core

Kenavon

As designed

Date: Fri Aug 19 09:24:09 2016

Administrative information

Building Details

Address: Retail, West Block, Kenavon Drive, READING,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.7.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jon West

Telephone number: 07758 760 818

Address: 62 High Street, Stetchworth, CB8 9TJ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	40.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	40.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	29.1
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	0 Ground (Retail) - Sales_W_10
Floor	0.25	0.13	0.13	0 Ground (Retail) - Sales_S_3
Roof	0.25	0.13	0.13	0 Ground (Retail) - Sales_R_5
Windows***, roof windows, and rooflights	2.2	1.6	1.6	0 Ground (Retail) - Sales_G_11
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

U_a-Limit = Limiting area-weighted average U-values [W/(m²K)]U_a-Calc = Calculated area-weighted average U-values [W/(m²K)]U_i-Calc = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	7

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- Heating by boiler and cooling by split units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.94	3.6	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* 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- DHW instantaneous electric

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	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		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
0 Ground (Retail) - Sales	-	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground (Retail) - WC	-	-	0.5	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
0 Ground (Retail) - Sales	YES
0 Ground (Retail) - WC	YES

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
0 Ground (Retail) - Sales	-	90	90	3979
0 Ground (Retail) - WC	-	90	-	36

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?
0 Ground (Retail) - Sales	NO (-6.8%)	NO
0 Ground (Retail) - WC	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]	406.9	406.9
External area [m ²]	640.3	640.3
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	7	3
Average conductance [W/K]	189.59	261.69
Average U-value [W/m ² K]	0.3	0.41
Alpha value* [%]	14.67	13.12

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	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 Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: 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/m²]

	Actual	Notional
Heating	10.73	13.64
Cooling	11.91	17.05
Auxiliary	0.17	0.2
Lighting	37.87	56.3
Hot water	1.68	1.94
Equipment*	20.25	20.25
TOTAL **	62.35	89.13

* Energy used by equipment does not count towards the total for calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	227.88	261.16
Primary energy* [kWh/m ²]	171.58	238.93
Total emissions [kg/m ²]	29.1	40.8

* 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] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	35.6	192.3	10.7	11.9	0.2	0.92	4.48	0.94	6
Notional	40.2	221	13.6	17	0.2	0.82	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
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* There might be more than one surface where the minimum U-value occurs.			

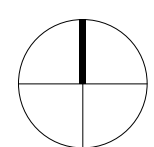
Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	7

Appendix E

PV Panels – Indicative Roof Plan



Total Roof Area = 7754.3 sq m



CDM REGULATIONS 2015. All current drawings and specifications for the project must be read in conjunction with the Designer's Hazard and Environment Assessment Record. All intellectual property rights reserved.

Rev	Date	Description
-	27/01/17	First Issue
A	22/03/17	For submission

Dwn	Ckd	Drawn	KR
FR	CS	Checked	CS
FR	CS	Date	Jan 2017
		Scale @ A1	1 : 500

Kenavon Drive
Site Plan Level 11 - Roof

AA5990-2021
REV A
FOR PLANNING

PRP