BASEENERGY
Building Assessments for a Sustainable Environment

Energy and Sustainability Statement

Client: PDA Architects
59 Royal Avenue
Reading
RG31 4UR

Site: 92 Yorktown Road
Sandhurst
GU47 9BH

Proposals: The construction of 15 new flats

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Appendices:

Report Details:

Prepared by	Checked by	Date	Project	Revision
Nicholas Gardner	Peter Kinsella BSc (Hons)	16.04.2020	7099	0.0

1 Introduction

This report and accompanying Energy Statement have been prepared in support of the planning application for the construction of 15 new dwellings at 92 Yorktown Road, Sandhurst, GU47 9BH.

Bracknell Forest Borough Council requires an Energy Statement to be in accordance with Policy CS10 – Sustainable Resources & CS12 – Renewable Energy:

'Development proposals for five or more net additional dwellings, or for 500 square metres (GEA) or more of floorspace for other development, will be accompanied by an energy demand assessment demonstrating how (potential) carbon dioxide emissions will be reduced by at least 10% and will provide at least 20% of their energy requirements from on-site renewable energy generation.'

Based on the above, the proposed dwellings will aim to achieve two sets of requirements:

- before taking account of any on-site renewable energy production the proposed development will reduce carbon dioxide emissions by at least 10% against the appropriate Target Emission Rate – Part L1A 2013 Building Regulations
- that a proportion of the development's energy requirements will be provided from on-site renewable energy production (which proportion shall be 20%)

This report will demonstrate 3 scenarios:

1 how the dwellings will meet current Building Regulation requirements for energy efficiency (baseline scenario)

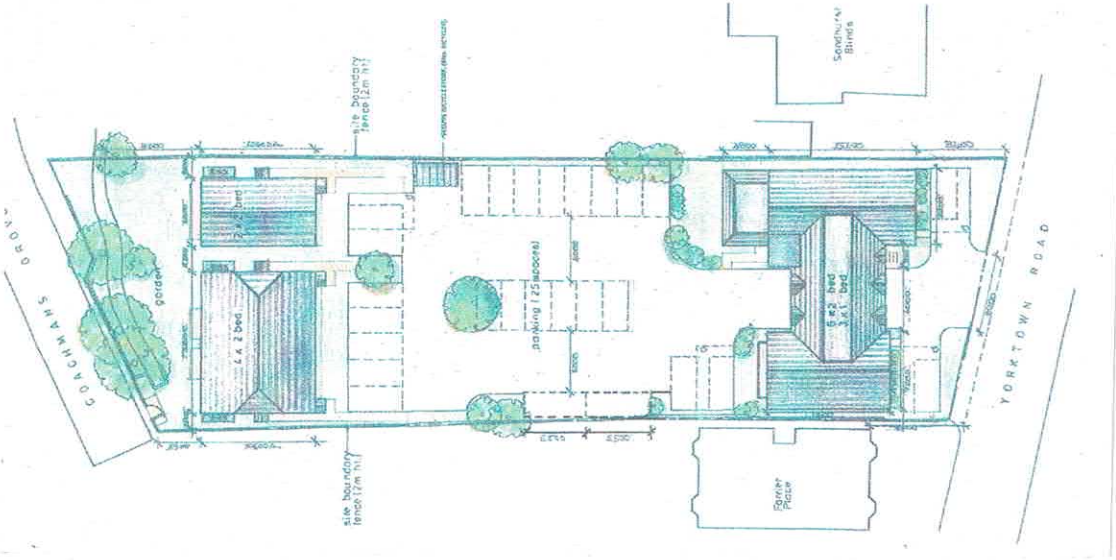
2 through an assessment of energy efficient measures shows how the dwellings can achieve a 10% reduction in CO2 emissions

3 through an assessment of renewable technologies, demonstrates how the dwellings can achieve the required 20% saving in CO2 emissions.

For the purpose of this report we have assessed a sample of the dwellings and displayed the results as an average.

2 Existing and Proposed Development

The site is located on land to 92 Yorktown Road, Sandhurst, GU47 9BH (see Figure 1).



As previously detailed, proposals are for the construction of 15 new dwellings at 92 Yorktown Road, Sandhurst, GU47 9BH.

Given the scale and nature of the site (in particular the adjacent buildings situated within close proximity to the development), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Access and egress for the proposed dwelling will be provided off Yorktown Road which leads from Wellington Road.

3 SAP 2012 and Building Regulations (2013)

The Standard Assessment Procedure (SAP) 2012 is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The SAP calculation takes into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction of the dwelling and the thermal insulation of building fabric (u-values[1])
- Ventilation of the dwelling
- Efficiency and control of heating systems
- Fuel used to provide space heating,
- Lighting
- Heat recovery systems
- Renewable technologies

Approved Document Part L of current Building Regulations (2013) addresses the conservation of fuel and power. Part L is divided into four separate documents:

- Part L1A Newly Constructed Dwellings
- Part L1B Existing Dwellings
- Part L2A Newly Constructed Non - Dwellings
- Part L2B Existing Non - Dwellings

Part L1A sets out the minimum energy efficiency requirements for ***new dwellings*** and is based on the SAP methodology.

To comply with Part L1A, the SAP calculation should demonstrate how the dwelling will either meet or achieve a percentage reduction in the Dwelling Emission Rate (DER) under the required Target Emission Rate (TER).

[1] U-values (Thermal Transmittance) - the measure of the overall rate of heat transfer by all mechanisms under standard conditions, through a particular section of a construction. Lower u-values mean better thermal insulation

London Energy Plan

The London Plan energy policies (specifically Policy 5.2) requires an energy assessment for each planning application referable to the Mayor, setting out how the London Plan energy policies will be met within the development. Specifically, applicants are required to set out how the proposals apply the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

The hierarchy provides the mechanism through which the carbon dioxide (CO2) emission reduction targets in Policy 5.2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

The following will report will follow the steps in line with this energy hierarchy, with minimising energy demand via fabric improvements, then use energy more efficiently and use heat recovery systems, then the final step is to use renewable technology.

4 Baseline Scenario (Part L1A Compliance; No Renewable Technologies)

In order to ensure that the dwellings meet (or exceed) the minimum standards as set out in Part L1A, the following measures are proposed:

- Insulation - good levels of insulation with u-values exceeding Part L1A requirements (see Table 1)

Table 1: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Proposed Dwellings
Walls	0.28	0.24
Ground Floor	0.22	0.16
Roof – Insulated at Rafters/Joists	0.18/0.16	0.16/0.12
Window/Glazed Doors	1.6	1.4

- Thermal Bridging - Accredited Construction Details provide the continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling. Keystone insulated lintels incorporated
- Ventilation - design air permeability (DAP) of between 5 & 6 m^3/hm^2 (@50Pa) (noting that a DAP of 10 m^3/hm^2 (@50Pa) or lower is the Part L1A minimum standard)
- Heating and Controls – 89.6% efficient combi boiler (a Worcester Greenstar 25i ErP has been modelled for the purpose of this report) with time and temperature zone control and a delayed start thermostat and flue gas heat recovery (Zenex GasSaver GS-1 has been modelled for the purpose of this report)
- Lighting - the design of the dwelling allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy

The above specification has been incorporated into the baseline SAP calculation; the results are summarised in Table 2 (with a sample baseline SAP worksheet provided in Appendix A).

Table 2: Baseline SAP Calculation Results

	Block of 9 Flats – Flat 1 – Ground floor Flat	Block of 9 Flats – Flat 6 – Mid-floor Flat	Block of 9 Flats – Flat 8 – Top-floor Flat	Block of 4 Flats – Ground Floor Flat	Block of 4 Flats – Top Floor Flat
Dwelling Emission Rate (DER) (kg CO2/m²/year)	18.04	15.85	17.12	18.23	17.35
Target Emission Rate (TER) (kg CO2/m²/year)	18.12	16.16	17.16	18.23	17.39
DER/TER Variance	-0.44%	-1.92%	-0.23%	-0.00%	-0.23%

Table 3: Baseline Area Weighted Average

	Baseline Calculation
Dwelling Emission Rate (DER) (kg CO2/m²/year)	17.38
Target Emission Rate (TER) (kg CO2/m²/year)	17.47
DER/TER Variance	-0.49%
Total TER Baseline CO2 Emissions (kg/year)	16,127
Total DER Baseline CO2 Emissions (kg/year)	16,048

The Baseline Target emission rate CO2 emissions are shown to be on average 17.47 kg/year.

The total Baseline CO2 emissions for all dwellings are shown to be an average 16,127 kg/year.

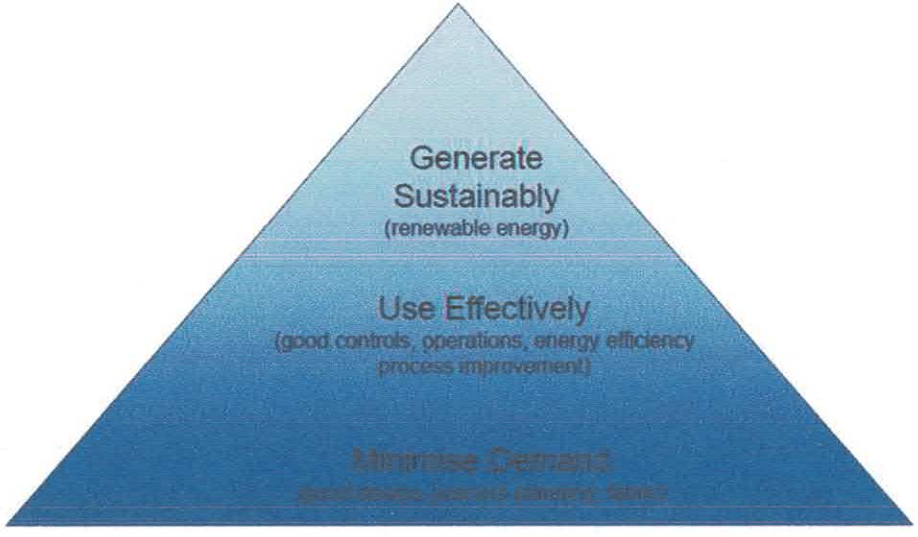
5 Energy Efficiency Improvement Scenario (Part L1A Compliance coupled with energy efficient improvements (No renewable Technologies)

Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

Useful improvements can be made at all levels, but maximum benefits will be achieved if we focus first on minimising total energy requirements, then look at making better use of the energy we currently use, before thinking about how best to generate it.



In order to ensure that the dwellings exceed the minimum standards as set out in Part L1A by at least 10%, the following measures have been improved and are as proposed:

Table 4: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Proposed Dwellings
Walls	0.28	0.18
Ground Floor	0.22	0.1
Roof – Insulated at Rafters/Joists	0.18/0.16	0.13/0.09
Window/Glazed Doors	1.6	1.2

- Insulation - good levels of insulation with u-values exceeding Part L1A requirements (see Table 1)
- Thermal Bridging - Accredited Construction Details provide the continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling, keystone insulated lintels have been incorporated
- Ventilation - design air permeability (DAP) of between 3 & 4 m^3/hm^2 (@50Pa) (noting that a DAP of 10 m^3/hm^2 (@50Pa) or lower is the Part L1A minimum standard)
- Heating and Controls – 89.6% efficient combi boiler (a Worcester Greenstar 25i ErP has been modelled for the purpose of this report) with time and temperature zone control and a delayed start thermostat and flue gas heat recovery (Zenex GasSaver GS-1 has been modelled for the purpose of this report)
- Lighting - the design of the dwelling allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy

The above specification has been incorporated into the baseline SAP calculation; the results are summarised in Table 6 (with a sample baseline SAP worksheet provided in Appendix B).

Table 5: Energy Efficient SAP Calculation Results – Be Lean

	Block of 9 Flats – Flat 1 – Ground floor Flat	Block of 9 Flats – Flat 6 – Mid-floor Flat	Block of 9 Flats – Flat 8 – Top-floor Flat	Block of 4 Flats – Ground Floor Flat	Block of 4 Flats – Top Floor Flat
Dwelling Emission Rate (DER) (kg CO2/m²/year)	15.71	14.54	15.43	16.38	15.57
Target Emission Rate (TER) (kg CO2/m²/year)	18.12	16.16	17.16	18.23	17.39
DER/TER Variance	-13.3%	-10.02%	-10.08%	-10.15%	-10.47%

Table 6: Be Lean Energy Efficient Area Weighted Average

	Energy Efficiency Calculation
Dwelling Emission Rate (DER) (kg CO2/m²/year)	15.55
Target Emission Rate (TER) (kg CO2/m²/year)	17.47
DER/TER Variance	-10.96%
Total TER Baseline CO2 Emissions (kg/year)	16,127
Total DER Baseline CO2 Emissions (kg/year)	14,359

The Baseline Target emission rate CO2 emissions are shown to be on average 17.47 kg/year.

The average energy efficiency emissions are shown to be 14,359 kg/year. When compared to the target baseline figure of 16,127 kg/year, this shows an overall average 10.96% reduction in CO2 emissions through the energy efficient measures detailed in section 5 of this report.

Therefore, this shows that the first requirement in line with Bracknell Forest Borough Council's policy CS10 can be feasibly met and the dwellings can achieve in excess of a 10% reduction in CO2 emissions through the incorporation of a fabric first approach

6 Renewable Technology Review

As previously detailed, in order to meet the requirements of Policy CS12, the proposed dwellings will need to achieve a further 20% saving in CO2 emissions through the provision of on-site renewable technologies.

The baseline calculation indicates that the total average CO2 emissions for the whole development are 16,127 kg/year. It has been shown that through the incorporation of energy efficient measures (detailed in Section 5 of this report) there can be an average reduction of 10.96% in CO2 emissions resulting in an overall 14,359kg/year. As such, to achieve a further 20% saving in CO2 emissions through renewable technologies we have conducted a feasibility study exploring a range of technologies that may be suitable to this development to help meet this requirement.

The Carbon Trust defines renewable energy as '*energy that occurs naturally and repeatedly in the environment. Therefore, it does not release any net greenhouse gases into the atmosphere*'.

There are a range of renewable technologies - some which generate electricity (such as photovoltaic (PV) panels, wind turbines), some which generate heat (such as ground source heat pumps, solar thermal panels for water heating), and some which generate both electricity and heat (Micro Combined Heat and Power). All can afford different benefits in reducing CO2 emissions from a dwelling. However, their feasibility depends on a number of factors including:

- Orientation
- Space (inside and outside of the dwelling)
- Surrounding topography
- Wind speed (for wind turbines)

In determining the most feasible renewable technologies for the dwelling, the following have been reviewed:

- Wind turbines
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Biomass
- Micro Combined Heat and Power
- Photovoltaic Panels
- Solar water heating

WIND TURBINES

Wind turbines are used to produce electricity. They can be either pole mounted (in a suitably exposed position) or building mounted; building mounted systems need a suitable wind resource, and subsequently both a structural survey and planning permission.

The immediate surrounding area is comprised of residential dwellings with the topography relatively flat.

When considering the space needed, cost and maintenance for wind turbines compared to other renewable technologies, we can conclude that wind turbines are not considered to be a suitable or feasible renewable technology for this particular development.

GROUND SOURCE HEAT PUMP (GSHP)

GSHPs use naturally occurring underground low-level heat in areas with appropriate geological features.

Heat is transferred from the ground by either extracting and discharging (re-charging) water from/to the ground directly (open loop) or circulating water through pipes buried within the ground, (closed loop). The water is passed through a heat pump in order to transfer the heat from this water into a higher temperature water circuit used for heating purposes. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

It is important to note that GSHPs require electricity to drive the pump and is therefore not considered a completely 'renewable' technology.

For a GSHP to be installed, there needs to be suitable outdoor space for digging a trench or borehole (and the associated digging machinery) to support the ground loop.

Based on the proposed site layout plan, there would be sufficient space for the installation of a vertical GSHP system, therefore, this technology would be considered a feasible solution to meet the energy requirement for this particular development.

AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorbs heat from outside air at a low temperature into a fluid which is then passed through a compressor where its temperature is increased. There are two main types of ASHP systems:

- Air to Water - distributes heat through the wet central heating
- Air to Air - produces warm air which is circulated by fans

Like GSHPs, ASHPs require electricity to drive the pump and therefore is not a completely 'renewable' system.

For an ASHP system to be installed, there needs to be ample outdoor space for the external condensing unit; these units can also be noisy and blow out colder air to the neighbouring environment.

Based on the proposed site layout plan, there would be sufficient space for the installation of an ASHP system, therefore, this technology would be considered a feasible solution to meet the energy requirement for this particular development.

BIOMASS

Biomass systems burn wood pellets, chips or logs to provide heat in a single room, or to power central heating and hot water boilers.

There needs to be ample space available for both the boiler and the storage of fuel. There will also be regular deliveries of fuel and therefore adequate site access is required.

In light of the small scale and nature of the development, and that there is no available storage for fuel, biomass is not considered an appropriate technology for this site.

COMBINED HEAT AND POWER (CHP)

CHP generates both heat and electricity from a single source. Large scale CHP has been available for commercial use for many years, with micro-CHP for the home being a relatively new technology.

Given the scale and nature of the development, and that micro-CHP is a relatively unknown technology at this stage, CHP has been discounted.

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semi-conducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp).

In general, PV cells should be installed so that they are orientated in a southerly direction (to face between south-east and south-west), in an un-shaded area.

Based on the proposed layout of the dwellings and that there is no significant over-shading, PV is considered a feasible solution in providing the 20% saving in CO2 emissions from the dwellings.

SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

There are three main types of solar heating (as defined by the Carbon Trust):

- Flat Plate Collectors - a sheet of black metal that absorbs the sun's energy encases the collector system. Water is fed through the system in pipes which conduct the heat to the water
- Evacuated Tubes - a series of parallel glass heat tubes grouped together, with each tube containing an absorber tube. Sunlight passes through the outer glass tube to heat the absorber tube which in doing so, the heat is transferred to water flowing through the tube
- Solar Matting - a range of extruded hollow sections of flexible black material that can be used for solar collection. Water passes through the hollow tubes absorbing the heat from the sun

Based on the proposed layout of the dwellings and that there is no significant over-shading, solar thermal would be a feasible solution in providing the 20% saving in CO2 emissions from the dwellings but would need to be combined with another technology.

Renewable Technology Summary

The renewable technology review indicates that the 3 most feasible solutions to achieve the overall 20% reduction in CO2 emissions from the dwellings (when compared with the baseline scenario) would be GSHP/ASHP, PV or solar thermal. All of these solutions would work well, given the proposed layout of the dwellings and that there is no significant over-shading for the solar panels.

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7 Renewable Technology Scenario (Part L1A Compliance; with a Ground Source Heat Pump)

In order to demonstrate how the dwellings can meet (or exceed) a 20% saving in CO2 emissions through the incorporation of on-site renewable energy, the energy efficiency SAP calculation (as detailed in Section 5 and Appendix B of this report) has been re-run with a solar PV as the preferred renewable energy solution.

An average 0.6 kWp PV system per flat has been incorporated into the SAP calculation (at a 30-45° angle, facing in a southern direction), noting that 0.25 kWp is the smallest sized system.

The results are summarised in Table 8 (with the baseline SAP worksheet provided in Appendix A and the Energy Efficiency SAP worksheet provided in Appendix B).

Table 7: SAP Calculation Results with PV

	Block of 9 Flats – Flat 1 – Ground floor Flat	Block of 9 Flats – Flat 6 – Mid-floor Flat	Block of 9 Flats – Flat 8 – Top-floor Flat	Block of 4 Flats – Ground Floor Flat	Block of 4 Flats – Top Floor Flat
Dwelling Emission Rate (DER) (kg CO2/m²/year)	11.93	9.36	11.61	11.84	11.37
Target Emission Rate (TER) (kg CO2/m²/year)	18.12	16.16	17.16	18.23	17.39
DER/TER Variance	-34.16%	-42.08%	-32.34	-35.05%	-34.62%

A comparison of the baseline, energy efficiency calculation results and the results of the calculation with the Solar PV included is shown in Table 8 below.

Table 8: Comparison of Calculations (Baseline, Be Lean and Be Green)

	Baseline Calculation	EE Calculation	PV Calculation
Dwelling Emission Rate (DER) (kg CO2/m²/year)	17.38	15.55	11.32
Target Emission Rate (TER) (kg CO2/m²/year)	17.47	17.47	17.47
DER/TER Variance	-0.49%	-10.96%	-35.21%
Total DER Baseline CO2 Emissions (kg/year)	16,127	16,127	16,127
Total TER Baseline CO2 Emissions (kg/year)	16,048	14,359	10,448

As required by the local council, a minimum 10% saving in CO2 emissions is to be provided through energy efficient measures and a further 20% reduction in CO2 emissions is to be provided through renewable technologies.

Table 8 shows that the baseline CO2 emissions for all dwellings are on average 16,127kg/year, the energy efficiency scenario shows that via the incorporation of the measures detailed in section 5 of this report, the overall average CO2 emissions are 14,359, which shows an overall average 10.96% reduction in CO2 emissions.

By including an average 0.6kWp Solar PV system per flat, the total dwellings CO2 emissions are shown to be on average 10,448 Kg/ year, when compared to the energy efficiency CO2 emission average of 14,359 this shows an average 21.25% reduction on CO2 emissions which exceeds the 20% requirement set by the local council.

The combination of energy efficiency measures and solar PV results in an overall average 35.21% reduction in CO2 emissions Kg/year.

Based on the above, the dwellings can therefore feasibly achieve the targets set out in the Core Strategy for a 10% reduction in CO2 emissions via fabric energy efficiency and a 20% reduction in CO2 emissions via renewable technologies.

9 Conclusion

There are proposals for the construction of 15 new dwellings at 92 Yorktown Road, Sandhurst, GU47 9BH.

Bracknell Forest Borough Council requires an Energy Statement to be in accordance with Policy CS10 – Sustainable Resources & CS12 – Renewable Energy which states a 10% saving in CO2 emissions through the provision energy efficient measures and a 20% saving in CO2 emissions through renewable technologies is required.

Given the scale and nature of the site (in particular the adjacent buildings situated within close proximity to the development), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies.

A review of renewable technologies indicates that solar PV would be the most feasible solution to meet the 20% requirement and this has been used for the basis of the assessment. This would be used in combination with a high standard of energy efficient measures to achieve the initial 10% as detailed below.

The following Be Green has been used in the Energy Statement

- Solar PV - average 0.6kWp system per dwelling
- 30-45^0 angle
- Facing in a southern direction
- No shading

This would be combined with the following Be Lean energy efficient measures

- Low fabric u-values
- High air tightness (air test of between 3 & 4)
- High efficiency heating system
- Flue Gas Heat Recovery
- Advanced heating controls

SAP 2012 has been used to calculate both a baseline scenario (to meet Building Regulation requirements) a scenario with energy efficiency measures and a scenario with solar PV (0.6kWp system per flat, 30-45^0 angle, facing in a southerly direction).
Through the incorporation of energy efficiency measures there is shown to be an average 10.96% reduction in CO2 emissions and through the incorporation of solar PV there is shown to be a further 21.25% reduction in CO2 emissions over Part L1A 2013 Building Regulations.

Appendices

Appendix A Sample DER Worksheet – Ground Floor Flat Baseline Scenario

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

Design SAP
elmhurst energy

Property Reference	S7099	Issued on Date	16/04/2020
Assessment Reference	Front Block Flat 1 - Baseline	Prop Type Ref	
Property	92-94, Yorktown Road, Sandhurst, GU47 9BH		

SAP Rating	83 B	DER	18.04	TER	18.12
Environmental	86 B	% DER<TER	0.42		
CO_2 Emissions (t/year)	1.16	DFEE	44.41	TFEE	46.45
General Requirements Compliance	Pass	% DFEE<TFEE	4.39		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	Assessor ID	L770-0002
Client			

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

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

DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.04 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 6.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
Manufacturer Manufacturer
Combi boiler
Efficiency: 90%
Minimum: 88% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 6.95 m², No overhang
Windows facing North West: 2.00 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1736	(8)
Pressure test		Yes	
Measured/design AP50		6.0000	
Infiltration rate		0.4736	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4025	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5132	0.5032	0.4931	0.4428	0.4327	0.3824	0.3824	0.3723	0.4025	0.4327	0.4528	0.4730	(22b)
Effective ac	0.6317	0.6266	0.6216	0.5980	0.5936	0.5731	0.5731	0.5693	0.5810	0.5936	0.6025	0.6119	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.40)			8.9500	1.3258	11.8655			(27)
Solid Door			2.2100	1.4000	3.0940			(26)
Heat Loss Floor 1			73.5500	0.1600	11.7680			(28a)
External Wall 1	49.1200	11.1600	37.9600	0.2400	9.1104			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.8379			(33)
Party Wall 1			39.0000	0.0000	0.0000			(32)
Party Ceilings 1			73.5500					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8230	(36)
Total fabric heat loss					(33) + (36) =		43.6609	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.0311	35.7394	35.4534	34.1104	33.8592	32.6895	32.6895	32.4729	33.1400	33.8592	34.3675	34.8989	(38)
Heat transfer coeff	79.6920	79.4003	79.1144	77.7714	77.5201	76.3504	76.3504	76.1338	76.8010	77.5201	78.0284	78.5598	(39)
Average = Sum(39)m / 12 =												77.7702	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0835	1.0795	1.0757	1.0574	1.0540	1.0381	1.0381	1.0351	1.0442	1.0540	1.0609	1.0681	(40)
HLP (average)												1.0574	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3291 (42)
Average daily hot water use (litres/day)		89.5170 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.1786	43.6745	46.5292	43.2625	42.8799	39.7308	41.0552	42.8799	43.2625	46.5292	46.7941	50.1786	(61)
Total heat required for water heating calculated for each month													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
								Total per year (kWh/year) = Sum(64)m =				1945.4059	(64)
Heat gains from water heating, kWh/month													
	61.0984	53.3840	55.4528	49.0194	47.3774	41.5653	39.5760	44.3562	44.8535	51.3002	54.9992	59.5663	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	82.1215	79.4405	74.5333	68.0825	63.6793	57.7295	53.1936	59.6185	62.2966	68.9519	76.3877	80.0623	(72)
Total internal gains													
	368.7614	365.9463	352.3057	330.8621	309.2243	288.4159	275.3788	281.9379	293.3494	314.9975	339.6679	358.2011	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	399.6229	428.7658	465.4864	516.7374	559.0771	554.7856	524.5621	480.5897	431.2620	391.7679	378.4997	383.4041	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	25.6369	25.7311	25.8241	26.2700	26.3552	26.7589	26.7589	26.8351	26.6020	26.3552	26.1835	26.0064	
alpha	2.7091	2.7154	2.7216	2.7513	2.7570	2.7839	2.7839	2.7890	2.7735	2.7570	2.7456	2.7338	
util living area													
	0.9728	0.9652	0.9471	0.9031	0.8190	0.6874	0.5587	0.6116	0.8054	0.9247	0.9631	0.9756	(86)
MIT	18.6576	18.8475	19.2390	19.8096	20.3390	20.7290	20.8916	20.8577	20.5396	19.8845	19.1952	18.6356	(87)
Th 2	20.0143	20.0176	20.0208	20.0358	20.0386	20.0517	20.0517	20.0542	20.0467	20.0386	20.0329	20.0270	(88)
util rest of house													
	0.9687	0.9599	0.9385	0.8862	0.7846	0.6232	0.4627	0.5182	0.7557	0.9082	0.9566	0.9719	(89)
MIT 2	16.8636	17.1411	17.7099	18.5357	19.2740	19.7909	19.9746	19.9460	19.5636	18.6553	17.6575	16.8387	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	17.8076	18.0390	18.5145	19.2060	19.8344	20.2845	20.4571	20.4257	20.0772	19.3021	18.4666	17.7842	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6576	17.8890	18.3645	19.0560	19.6844	20.1345	20.3071	20.2757	19.9272	19.1521	18.3166	17.6342	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9549	0.9440	0.9193	0.8649	0.7700	0.6294	0.4902	0.5418	0.7484	0.8886	0.9406	0.9591	(94)
Useful gains	381.5862	404.7354	427.9385	446.9258	430.4689	349.1644	257.1406	260.3877	322.7765	348.1427	356.0215	367.7208	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1064.4920	1031.3264	938.6509	789.8427	618.9497	422.5592	283.0406	295.0722	447.5308	662.9600	875.2129	1055.3872	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	508.0819	421.0692	379.9700	246.9002	140.2297	0.0000	0.0000	0.0000	0.0000	234.2241	373.8178	511.6238	(98)
Space heating												2815.9166	(98)
Space heating per m2											(98) / (4) =	38.2857	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)											0.0000	(201)
Fraction of space heat from main system(s)											1.0000	(202)
Efficiency of main space heating system 1 (in %)											92.6000	(206)
Efficiency of secondary/supplementary heating system, %											0.0000	(208)
Space heating requirement											3040.9467	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	508.0819	421.0692	379.9700	246.9002	140.2297	0.0000	0.0000	0.0000	0.0000	234.2241	373.8178	511.6238	(98)
Space heating efficiency (main heating system 1)													
	92.6000	92.6000	92.6000	92.6000	92.6000	0.0000	0.0000	0.0000	0.0000	92.6000	92.6000	92.6000	(210)
Space heating fuel (main heating system)													
	548.6846	454.7183	410.3348	266.6309	151.4360	0.0000	0.0000	0.0000	0.0000	252.9418	403.6909	552.5095	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
Efficiency of water heater												89.6000	(216)
(217)m	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	89.6000	(217)
Fuel for water heating, kWh/month													
	218.9786	191.2834	199.0180	176.5190	170.9015	150.5205	144.2101	160.7605	162.5359	185.0795	197.5687	213.8361	(219)
Water heating fuel used												2171.2119	(219)
Annual totals kWh/year													
Space heating fuel - main system												3040.9467	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Total delivered energy for all uses												5600.0640	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3040.9467	0.2160	656.8445	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2171.2119	0.2160	468.9818	(264)
Space and water heating			1125.8263	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Total CO2, kg/year			1327.1492	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0400	(273)

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

DER		18.0400	ZC1
Total Floor Area	TFA	73.5500	
Assumed number of occupants	N	2.3291	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5517	ZC2
CO2 emissions from cooking, equation (L16)		2.3780	ZC3
Total CO2 emissions		36.9696	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		36.9696	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1736	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4236	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3600	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4590	0.4500	0.4410	0.3960	0.3870	0.3420	0.3420	0.3330	0.3600	0.3870	0.4050	0.4230	(22b)
Effective ac	0.6054	0.6013	0.5973	0.5784	0.5749	0.5585	0.5585	0.5555	0.5648	0.5749	0.5820	0.5895	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2100	1.0000	2.2100			(26)
TER Opening Type (Uw = 1.40)			8.9500	1.3258	11.8655			(27)
Heat Loss Floor 1			73.5500	0.1300	9.5615			(28a)
External Wall 1	49.1200	11.1600	37.9600	0.1800	6.8328			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.4698			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.5625	(36)
Total fabric heat loss (33) + (36) =	37.0323	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.5285	34.2952	34.0664	32.9921	32.7911	31.8553	31.8553	31.6820	32.2158	32.7911	33.1977	33.6228	(38)
Heat transfer coeff	71.5609	71.3275	71.0988	70.0244	69.8234	68.8877	68.8877	68.7144	69.2481	69.8234	70.2300	70.6552	(39)
Average = Sum(39)m / 12 =												70.0234	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9730	0.9698	0.9667	0.9521	0.9493	0.9366	0.9366	0.9343	0.9415	0.9493	0.9549	0.9606	(40)
HLP (average)												0.9521	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3291 (42)
Average daily hot water use (litres/day)	89.5170 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.1786	43.6745	46.5292	43.2625	42.8799	39.7308	41.0552	42.8799	43.2625	46.5292	46.7941	50.1786	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
									Total per year (kWh/year) = Sum(64)m =			1945.4059	(64)
Heat gains from water heating, kWh/month													
	61.0984	53.3840	55.4528	49.0194	47.3774	41.5653	39.5760	44.3562	44.8535	51.3002	54.9992	59.5663	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	82.1215	79.4405	74.5333	68.0825	63.6793	57.7295	53.1936	59.6185	62.2966	68.9519	76.3877	80.0623	(72)
Total internal gains													
	368.7614	365.9463	352.3057	330.8621	309.2243	288.4159	275.3788	281.9379	293.3494	314.9975	339.6679	358.2011	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	399.6229	428.7658	465.4864	516.7374	559.0771	554.7856	524.5621	480.5897	431.2620	391.7679	378.4997	383.4041	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	71.3748	71.6083	71.8386	72.9408	73.1508	74.1445	74.1445	74.3315	73.7586	73.1508	72.7273	72.2897	
alpha	5.7583	5.7739	5.7892	5.8627	5.8767	5.9430	5.9430	5.9554	5.9172	5.8767	5.8485	5.8193	
util living area	0.9988	0.9979	0.9945	0.9778	0.9103	0.7425	0.5682	0.6381	0.8954	0.9876	0.9976	0.9991	(86)
MIT	19.9498	20.0487	20.2496	20.5469	20.8139	20.9615	20.9933	20.9875	20.8783	20.5504	20.2075	19.9367	(87)
Th 2	20.1059	20.1086	20.1112	20.1235	20.1258	20.1365	20.1365	20.1385	20.1324	20.1258	20.1211	20.1163	(88)
util rest of house	0.9984	0.9972	0.9924	0.9689	0.8754	0.6624	0.4618	0.5285	0.8414	0.9812	0.9966	0.9987	(89)
MIT 2	18.6911	18.8377	19.1326	19.5701	19.9338	20.1095	20.1338	20.1328	20.0257	19.5808	19.0793	18.6797	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9965	0.9913	0.9685	0.8874	0.7032	0.5181	0.5864	0.8652	0.9809	0.9960	0.9984	(94)
Useful gains	398.7893	427.2471	461.4329	500.4412	496.1381	390.1029	271.7657	281.8365	373.1241	384.2713	376.9698	382.7761	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1077.2347	1039.5922	939.9523	783.1573	607.2453	410.4182	274.5908	287.3986	441.4121	662.6920	882.9966	1069.7980	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating												2641.1255	(98)
Space heating per m2											(98) / (4) =	35.9093	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2827.7575	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	540.4319	440.5737	381.1761	217.9396	88.5050	0.0000	0.0000	0.0000	0.0000	221.7826	390.0849	547.2637	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3256	87.1759	86.7583	85.6875	83.5735	80.3000	80.3000	80.3000	80.3000	85.6123	86.8288	87.4027	(217)
Fuel for water heating, kWh/month													
	224.6819	196.6024	205.5367	184.5789	183.2253	167.9531	160.9119	179.3791	181.3601	193.7003	203.8742	219.2119	(219)
Water heating fuel used												2301.0157	(219)
Annual totals kWh/year													
Space heating fuel - main system												2827.7575	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Total delivered energy for all uses												5561.6786	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2827.7575	0.2160	610.7956	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2301.0157	0.2160	497.0194	(264)
Space and water heating			1107.8150	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Total CO2, kg/m2/year			1332.4929	(272)
Emissions per m2 for space and water heating			15.0621	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5255	(272b)
Emissions per m2 for pumps and fans			0.5292	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0621 * 1.00) + 2.5255 + 0.5292, rounded to 2 d.p.			18.1200	(273)

Appendix B: Sample DER Worksheet - Ground Floor Flat With Energy Efficient Measures

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

Design SAP
elmhurst energy

Property Reference	S7099	Issued on Date	16/04/2020
Assessment Reference	Front Block Flat 1 - EE	Prop Type Ref	
Property	92-94, Yorktown Road, Sandhurst, GU47 9BH		

SAP Rating	85 B	DER	15.71	TER	18.12
Environmental	88 B	% DER<TER	13.29		
CO_2 Emissions (t/year)	1.00	DFEE	36.03	TFEE	46.45
General Requirements Compliance	Pass	% DFEE<TFEE	22.43		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	Assessor ID	L770-0002
Client			

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

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

DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.71 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)36.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.16 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 25i ErP
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 6.95 m², No overhang
Windows facing North West: 2.00 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.10 W/m²K
Door U-value 1.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1736	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3736	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3175	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4049	0.3969	0.3890	0.3493	0.3413	0.3017	0.3017	0.2937	0.3175	0.3413	0.3572	0.3731	(22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			8.9500	1.1450	10.2481			(27)
Solid Door			2.2100	1.0000	2.2100			(26)
Heat Loss Floor 1			73.5500	0.1000	7.3550			(28a)
External Wall 1	49.1200	11.6100	37.9600	0.1800	6.8328			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.6459			(33)
Party Wall 1			39.0000	0.0000	0.0000			(32)
Party Ceilings 1			73.5500					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8230	(36)
Total fabric heat loss					(33) + (36) =		34.4689	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.1935	33.0120	32.8341	31.9984	31.8420	31.1141	31.1141	30.9794	31.3945	31.8420	32.1583	32.4890	(38)
Heat transfer coeff	67.6624	67.4809	67.3029	66.4673	66.3109	65.5830	65.5830	65.4482	65.8634	66.3109	66.6272	66.9579	(39)
Average = Sum(39)m / 12 =												66.4665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9200	0.9175	0.9151	0.9037	0.9016	0.8917	0.8917	0.8898	0.8955	0.9016	0.9059	0.9104	(40)
HLP (average)												0.9037	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3291	(42)
Average daily hot water use (litres/day)												89.5170	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	32.7543	29.5845	32.7543	31.6977	32.7543	31.6977	32.7543	32.7543	31.6977	32.7543	31.6977	32.7543	(61)
Total heat required for water heating calculated for each month													
	178.7805	157.3000	164.5452	146.5962	143.0022	126.8332	120.9114	133.9158	134.0674	152.0563	161.9252	174.1729	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-24.6667	-21.1726	-20.6315	-16.3605	-12.7370	-7.9909	-7.5265	-8.4628	-8.5117	-16.5549	-20.5378	-24.4352	eq.(G5)
Output from w/h													
	154.1139	136.1274	143.9137	130.2357	130.2652	118.8424	113.3849	125.4530	125.5557	135.5015	141.3874	149.7377	(64)
									Total per year (kWh/year) = Sum(64)m =			1604.5184	(64)
Heat gains from water heating, kWh/month													
	56.7423	49.8615	52.0091	46.1282	44.8460	39.5570	37.5008	41.8248	41.9624	47.8565	51.2251	55.2103	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	76.2665	74.1987	69.9047	64.0669	60.2769	54.9403	50.4043	56.2161	58.2810	64.3232	71.1459	74.2073	(72)
Total internal gains													
	362.9065	360.7045	347.6770	326.8465	305.8218	285.6267	272.5895	278.5355	289.3339	310.3688	334.4261	352.3461	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	393.7680	423.5240	460.8577	512.7219	555.6747	551.9963	521.7729	477.1873	427.2464	387.1392	373.2579	377.5492	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.1949	30.2761	30.3561	30.7378	30.8103	31.1522	31.1522	31.2164	31.0196	30.8103	30.6640	30.5125	
alpha	3.0130	3.0184	3.0237	3.0492	3.0540	3.0768	3.0768	3.0811	3.0680	3.0540	3.0443	3.0342	
util living area	0.9724	0.9636	0.9426	0.8904	0.7911	0.6438	0.5092	0.5644	0.7769	0.9168	0.9615	0.9755	(86)
MIT	19.0282	19.2080	19.5681	20.0766	20.5293	20.8283	20.9389	20.9153	20.6736	20.1104	19.4948	18.9958	(87)
Th 2	20.1506	20.1527	20.1547	20.1644	20.1662	20.1746	20.1746	20.1761	20.1713	20.1662	20.1625	20.1587	(88)
util rest of house	0.9685	0.9585	0.9340	0.8733	0.7572	0.5849	0.4274	0.4826	0.7287	0.9003	0.9551	0.9721	(89)
MIT 2	17.4788	17.7408	18.2626	18.9937	19.6186	20.0077	20.1298	20.1103	19.8258	19.0536	18.1656	17.4367	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	18.2940	18.5128	18.9495	19.5635	20.0978	20.4395	20.5556	20.5339	20.2719	19.6096	18.8650	18.2571	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1440	18.3628	18.7995	19.4135	19.9478	20.2895	20.4056	20.3839	20.1219	19.4596	18.7150	18.1071	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9441	0.9167	0.8550	0.7473	0.5936	0.4512	0.5043	0.7255	0.8830	0.9406	0.9605	(94)
Useful gains	376.4693	399.8339	422.4555	438.3946	415.2644	327.6865	235.4148	240.6625	309.9477	341.8518	351.1046	362.6519	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	936.7211	908.4789	827.7953	698.8041	546.9176	373.1318	249.5800	260.7371	396.6235	587.4904	773.8764	931.1876	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	416.8274	341.8094	301.5728	187.4949	97.9500	0.0000	0.0000	0.0000	0.0000	182.7552	304.3957	422.9905	(98)
Space heating												2255.7958	(98)
Space heating per m2											(98) / (4) =	30.6702	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2492.5921	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	416.8274	341.8094	301.5728	187.4949	97.9500	0.0000	0.0000	0.0000	0.0000	182.7552	304.3957	422.9905	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	460.5827	377.6900	333.2296	207.1767	108.2320	0.0000	0.0000	0.0000	0.0000	201.9394	336.3488	467.3929	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	154.1139	136.1274	143.9137	130.2357	130.2652	118.8424	113.3849	125.4530	125.5557	135.5015	141.3874	149.7377	(64)
Efficiency of water heater												86.6000	(216)
(217)m	89.4131	89.3539	89.2023	88.8597	88.2319	86.6000	86.6000	86.6000	86.6000	88.7974	89.2255	89.4468	(217)
Fuel for water heating, kWh/month													
	172.3616	152.3464	161.3342	146.5633	147.6395	137.2314	130.9294	144.8649	144.9835	152.5962	158.4606	167.4042	(219)
Water heating fuel used												1816.7152	(219)
Annual totals kWh/year													
Space heating fuel - main system												2492.5921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Total delivered energy for all uses												4742.2127	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2492.5921	0.2160	538.3999	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1816.7152	0.2160	392.4105	(264)
Space and water heating			930.8104	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Total CO2, kg/year			1155.4883	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.7100	(273)

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

DER		15.7100	ZC1
Total Floor Area	TFA	73.5500	
Assumed number of occupants	N	2.3291	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5517	ZC2
CO2 emissions from cooking, equation (L16)		2.3780	ZC3
Total CO2 emissions		34.6396	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.6396	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1736	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4236	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3600	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4590	0.4500	0.4410	0.3960	0.3870	0.3420	0.3420	0.3330	0.3600	0.3870	0.4050	0.4230	(22b)
Effective ac	0.6054	0.6013	0.5973	0.5784	0.5749	0.5585	0.5585	0.5555	0.5648	0.5749	0.5820	0.5895	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2100	1.0000	2.2100			(26)
TER Opening Type (Uw = 1.40)			8.9500	1.3258	11.8655			(27)
Heat Loss Floor 1			73.5500	0.1300	9.5615			(28a)
External Wall 1	49.1200	11.1600	37.9600	0.1800	6.8328			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4698			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5625	(36)
Total fabric heat loss						(33) + (36) =	37.0323	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.5285	34.2952	34.0664	32.9921	32.7911	31.8553	31.8553	31.6820	32.2158	32.7911	33.1977	33.6228	(38)
Heat transfer coeff	71.5609	71.3275	71.0988	70.0244	69.8234	68.8877	68.8877	68.7144	69.2481	69.8234	70.2300	70.6552	(39)
Average = Sum(39)m / 12 =												70.0234	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9730	0.9698	0.9667	0.9521	0.9493	0.9366	0.9366	0.9343	0.9415	0.9493	0.9549	0.9606	(40)
HLP (average)												0.9521	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3291	(42)
Average daily hot water use (litres/day)												89.5170	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.1786	43.6745	46.5292	43.2625	42.8799	39.7308	41.0552	42.8799	43.2625	46.5292	46.7941	50.1786	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

Output from w/h

	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972 (64)
								Total per year (kWh/year) = Sum(64)m =				1945.4059 (64)

Heat gains from water heating, kWh/month

	61.0984	53.3840	55.4528	49.0194	47.3774	41.5653	39.5760	44.3562	44.8535	51.3002	54.9992	59.5663 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	82.1215	79.4405	74.5333	68.0825	63.6793	57.7295	53.1936	59.6185	62.2966	68.9519	76.3877	80.0623	(72)
Total internal gains													
	368.7614	365.9463	352.3057	330.8621	309.2243	288.4159	275.3788	281.9379	293.3494	314.9975	339.6679	358.2011	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	399.6229	428.7658	465.4864	516.7374	559.0771	554.7856	524.5621	480.5897	431.2620	391.7679	378.4997	383.4041	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	71.3748	71.6083	71.8386	72.9408	73.1508	74.1445	74.1445	74.3315	73.7586	73.1508	72.7273	72.2897	
alpha	5.7583	5.7739	5.7892	5.8627	5.8767	5.9430	5.9430	5.9554	5.9172	5.8767	5.8485	5.8193	
util living area													
	0.9988	0.9979	0.9945	0.9778	0.9103	0.7425	0.5682	0.6381	0.8954	0.9876	0.9976	0.9991	(86)
MIT	19.9498	20.0487	20.2496	20.5469	20.8139	20.9615	20.9933	20.9875	20.8783	20.5504	20.2075	19.9367	(87)
Th 2	20.1059	20.1086	20.1112	20.1235	20.1258	20.1365	20.1365	20.1385	20.1324	20.1258	20.1211	20.1163	(88)
util rest of house													
	0.9984	0.9972	0.9924	0.9689	0.8754	0.6624	0.4618	0.5285	0.8414	0.9812	0.9966	0.9987	(89)
MIT 2	18.6911	18.8377	19.1326	19.5701	19.9338	20.1095	20.1338	20.1328	20.0257	19.5808	19.0793	18.6797	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9965	0.9913	0.9685	0.8874	0.7032	0.5181	0.5864	0.8652	0.9809	0.9960	0.9984	(94)
Useful gains	398.7893	427.2471	461.4329	500.4412	496.1381	390.1029	271.7657	281.8365	373.1241	384.2713	376.9698	382.7761	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1077.2347	1039.5922	939.9523	783.1573	607.2453	410.4182	274.5908	287.3986	441.4121	662.6920	882.9966	1069.7980	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating												2641.1255	(98)
Space heating per m2											(98) / (4) =	35.9093	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2827.7575	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	540.4319	440.5737	381.1761	217.9396	88.5050	0.0000	0.0000	0.0000	0.0000	221.7826	390.0849	547.2637	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3256	87.1759	86.7583	85.6875	83.5735	80.3000	80.3000	80.3000	80.3000	85.6123	86.8288	87.4027	(217)
Fuel for water heating, kWh/month													
	224.6819	196.6024	205.5367	184.5789	183.2253	167.9531	160.9119	179.3791	181.3601	193.7003	203.8742	219.2119	(219)
Water heating fuel used												2301.0157	(219)
Annual totals kWh/year													
Space heating fuel - main system												2827.7575	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Total delivered energy for all uses												5561.6786	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2827.7575	0.2160	610.7956	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2301.0157	0.2160	497.0194	(264)
Space and water heating			1107.8150	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Total CO2, kg/m2/year			1332.4929	(272)
Emissions per m2 for space and water heating			15.0621	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5255	(272b)
Emissions per m2 for pumps and fans			0.5292	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0621 * 1.00) + 2.5255 + 0.5292, rounded to 2 d.p.			18.1200	(273)

Appendix C: Sample DER Worksheet - Ground Floor Flat With Renewable Technology

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

Design SAP
elmhurst energy

Property Reference	S7099	Issued on Date	16/04/2020
Assessment Reference	Front Block Flat 1 - PV	Prop Type Ref	
Property	92-94, Yorktown Road, Sandhurst, GU47 9BH		

SAP Rating	88 B	DER	11.93	TER	18.12
Environmental	91 B	% DER<TER	34.15		
CO_2 Emissions (t/year)	0.70	DFEE	36.03	TFEE	46.45
General Requirements Compliance	Pass	% DFEE<TFEE	22.43		

Assessor Details	Mr. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, peter@baseenergy.co.uk	Assessor ID	L770-0002
Client			

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

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

DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)36.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.16 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 25i ErP
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 6.95 m², No overhang
Windows facing North West: 2.00 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Photovoltaic array 0.65 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1736	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3736	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3175	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4049	0.3969	0.3890	0.3493	0.3413	0.3017	0.3017	0.2937	0.3175	0.3413	0.3572	0.3731	(22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			8.9500	1.1450	10.2481			(27)
Solid Door			2.2100	1.0000	2.2100			(26)
Heat Loss Floor 1			73.5500	0.1000	7.3550			(28a)
External Wall 1	49.1200	11.6000	37.9600	0.1800	6.8328			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.6459			(33)
Party Wall 1			39.0000	0.0000	0.0000			(32)
Party Ceilings 1			73.5500					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8230	(36)
Total fabric heat loss					(33) + (36) =		34.4689	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.1935	33.0120	32.8341	31.9984	31.8420	31.1141	31.1141	30.9794	31.3945	31.8420	32.1583	32.4890	(38)
Heat transfer coeff	67.6624	67.4809	67.3029	66.4673	66.3109	65.5830	65.5830	65.4482	65.8634	66.3109	66.6272	66.9579	(39)
Average = Sum(39)m / 12 =												66.4665	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9200	0.9175	0.9151	0.9037	0.9016	0.8917	0.8917	0.8898	0.8955	0.9016	0.9059	0.9104	(40)
HLP (average)												0.9037	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3291 (42)
Average daily hot water use (litres/day)		89.5170 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	32.7543	29.5845	32.7543	31.6977	32.7543	31.6977	32.7543	32.7543	31.6977	32.7543	31.6977	32.7543	(61)
Total heat required for water heating calculated for each month													
	178.7805	157.3000	164.5452	146.5962	143.0022	126.8332	120.9114	133.9158	134.0674	152.0563	161.9252	174.1729	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-24.6667	-21.1726	-20.6315	-16.3605	-12.7370	-7.9909	-7.5265	-8.4628	-8.5117	-16.5549	-20.5378	-24.4352	eq.(G5)
Output from w/h													
	154.1139	136.1274	143.9137	130.2357	130.2652	118.8424	113.3849	125.4530	125.5557	135.5015	141.3874	149.7377	(64)
									Total per year (kWh/year) = Sum(64)m =			1604.5184	(64)
Heat gains from water heating, kWh/month													
	56.7423	49.8615	52.0091	46.1282	44.8460	39.5570	37.5008	41.8248	41.9624	47.8565	51.2251	55.2103	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	76.2665	74.1987	69.9047	64.0669	60.2769	54.9403	50.4043	56.2161	58.2810	64.3232	71.1459	74.2073	(72)
Total internal gains													
	362.9065	360.7045	347.6770	326.8465	305.8218	285.6267	272.5895	278.5355	289.3339	310.3688	334.4261	352.3461	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	393.7680	423.5240	460.8577	512.7219	555.6747	551.9963	521.7729	477.1873	427.2464	387.1392	373.2579	377.5492	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.1949	30.2761	30.3561	30.7378	30.8103	31.1522	31.1522	31.2164	31.0196	30.8103	30.6640	30.5125	
alpha	3.0130	3.0184	3.0237	3.0492	3.0540	3.0768	3.0768	3.0811	3.0680	3.0540	3.0443	3.0342	
util living area													
	0.9724	0.9636	0.9426	0.8904	0.7911	0.6438	0.5092	0.5644	0.7769	0.9168	0.9615	0.9755	(86)
MIT	19.0282	19.2080	19.5681	20.0766	20.5293	20.8283	20.9389	20.9153	20.6736	20.1104	19.4948	18.9958	(87)
Th 2	20.1506	20.1527	20.1547	20.1644	20.1662	20.1746	20.1746	20.1761	20.1713	20.1662	20.1625	20.1587	(88)
util rest of house													
	0.9685	0.9585	0.9340	0.8733	0.7572	0.5849	0.4274	0.4826	0.7287	0.9003	0.9551	0.9721	(89)
MIT 2	17.4788	17.7408	18.2626	18.9937	19.6186	20.0077	20.1298	20.1103	19.8258	19.0536	18.1656	17.4367	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	18.2940	18.5128	18.9495	19.5635	20.0978	20.4395	20.5556	20.5339	20.2719	19.6096	18.8650	18.2571	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1440	18.3628	18.7995	19.4135	19.9478	20.2895	20.4056	20.3839	20.1219	19.4596	18.7150	18.1071	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9561	0.9441	0.9167	0.8550	0.7473	0.5936	0.4512	0.5043	0.7255	0.8830	0.9406	0.9605	(94)
Useful gains	376.4693	399.8339	422.4555	438.3946	415.2644	327.6865	235.4148	240.6625	309.9477	341.8518	351.1046	362.6519	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	936.7211	908.4789	827.7953	698.8041	546.9176	373.1318	249.5800	260.7371	396.6235	587.4904	773.8764	931.1876	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	416.8274	341.8094	301.5728	187.4949	97.9500	0.0000	0.0000	0.0000	0.0000	182.7552	304.3957	422.9905	(98)
Space heating												2255.7958	(98)
Space heating per m2											(98) / (4) =	30.6702	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2492.5921	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	416.8274	341.8094	301.5728	187.4949	97.9500	0.0000	0.0000	0.0000	0.0000	182.7552	304.3957	422.9905	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	460.5827	377.6900	333.2296	207.1767	108.2320	0.0000	0.0000	0.0000	0.0000	201.9394	336.3488	467.3929	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	154.1139	136.1274	143.9137	130.2357	130.2652	118.8424	113.3849	125.4530	125.5557	135.5015	141.3874	149.7377	(64)
Efficiency of water heater												86.6000	(216)
(217)m	89.4131	89.3539	89.2023	88.8597	88.2319	86.6000	86.6000	86.6000	86.6000	88.7974	89.2255	89.4468	(217)
Fuel for water heating, kWh/month													
	172.3616	152.3464	161.3342	146.5633	147.6395	137.2314	130.9294	144.8649	144.9835	152.5962	158.4606	167.4042	(219)
Water heating fuel used												1816.7152	(219)
Annual totals kWh/year													
Space heating fuel - main system												2492.5921	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.65 * 1029 * 1.00) =										-535.1771		-535.1771	(233)
Total delivered energy for all uses												4207.0356	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2492.5921	0.2160	538.3999	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1816.7152	0.2160	392.4105	(264)
Space and water heating			930.8104	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Energy saving/generation technologies				
PV Unit	-535.1771	0.5190	-277.7569	(269)
Total CO2, kg/year			877.7314	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.9300	(273)

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

DER		11.9300	ZC1
Total Floor Area	TFA	73.5500	
Assumed number of occupants	N	2.3291	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5517	ZC2
CO2 emissions from cooking, equation (L16)		2.3780	ZC3
Total CO2 emissions		30.8596	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.8596	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.5500 (1b)	x	2.3500 (2b)	=	172.8425	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.5500					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	172.8425	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1736	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4236	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3600	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4590	0.4500	0.4410	0.3960	0.3870	0.3420	0.3420	0.3330	0.3600	0.3870	0.4050	0.4230	(22b)
Effective ac	0.6054	0.6013	0.5973	0.5784	0.5749	0.5585	0.5585	0.5555	0.5648	0.5749	0.5820	0.5895	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2100	1.0000	2.2100			(26)
TER Opening Type (Uw = 1.40)			8.9500	1.3258	11.8655			(27)
Heat Loss Floor 1			73.5500	0.1300	9.5615			(28a)
External Wall 1	49.1200	11.1600	37.9600	0.1800	6.8328			(29a)
Total net area of external elements Aum(A, m2)			122.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.4698			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5625	(36)
Total fabric heat loss						(33) + (36) =	37.0323	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.5285	34.2952	34.0664	32.9921	32.7911	31.8553	31.8553	31.6820	32.2158	32.7911	33.1977	33.6228	(38)
Heat transfer coeff	71.5609	71.3275	71.0988	70.0244	69.8234	68.8877	68.8877	68.7144	69.2481	69.8234	70.2300	70.6552	(39)
Average = Sum(39)m / 12 =												70.0234	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9730	0.9698	0.9667	0.9521	0.9493	0.9366	0.9366	0.9343	0.9415	0.9493	0.9549	0.9606	(40)
HLP (average)												0.9521	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3291	(42)
Average daily hot water use (litres/day)	89.5170	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.4687	94.8880	91.3073	87.7267	84.1460	80.5653	80.5653	84.1460	87.7267	91.3073	94.8880	98.4687	(44)
Energy conte	146.0262	127.7155	131.7909	114.8985	110.2479	95.1355	88.1571	101.1615	102.3697	119.3020	130.2275	141.4186	(45)
Energy content (annual)										Total = Sum(45)m =		1408.4510	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9039	19.1573	19.7686	17.2348	16.5372	14.2703	13.2236	15.1742	15.3555	17.8953	19.5341	21.2128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.1786	43.6745	46.5292	43.2625	42.8799	39.7308	41.0552	42.8799	43.2625	46.5292	46.7941	50.1786	(61)

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Total heat required for water heating calculated for each month

	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
								Total per year (kWh/year) = Sum(64)m =				1945.4059	(64)
Heat gains from water heating, kWh/month													
	61.0984	53.3840	55.4528	49.0194	47.3774	41.5653	39.5760	44.3562	44.8535	51.3002	54.9992	59.5663	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	116.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2661	18.0002	14.6387	11.0824	8.2843	6.9939	7.5572	9.8231	13.1846	16.7408	19.5390	20.8293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.4368	207.5686	202.1966	190.7601	176.3237	162.7554	153.6910	151.5592	156.9313	168.3677	182.8042	196.3724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	34.6457	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	-93.1655	(71)
Water heating gains (Table 5)													
	82.1215	79.4405	74.5333	68.0825	63.6793	57.7295	53.1936	59.6185	62.2966	68.9519	76.3877	80.0623	(72)
Total internal gains													
	368.7614	365.9463	352.3057	330.8621	309.2243	288.4159	275.3788	281.9379	293.3494	314.9975	339.6679	358.2011	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.9500	11.2829	0.6300	0.7000	0.7700	23.9651	(75)
Northwest	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964	(81)

Solar gains	30.8615	62.8195	113.1808	185.8753	249.8529	266.3696	249.1833	198.6518	137.9125	76.7704	38.8318	25.2031	(83)
Total gains	399.6229	428.7658	465.4864	516.7374	559.0771	554.7856	524.5621	480.5897	431.2620	391.7679	378.4997	383.4041	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	71.3748	71.6083	71.8386	72.9408	73.1508	74.1445	74.1445	74.3315	73.7586	73.1508	72.7273	72.2897	
alpha	5.7583	5.7739	5.7892	5.8627	5.8767	5.9430	5.9430	5.9554	5.9172	5.8767	5.8485	5.8193	
util living area	0.9988	0.9979	0.9945	0.9778	0.9103	0.7425	0.5682	0.6381	0.8954	0.9876	0.9976	0.9991	(86)
MIT	19.9498	20.0487	20.2496	20.5469	20.8139	20.9615	20.9933	20.9875	20.8783	20.5504	20.2075	19.9367	(87)
Th 2	20.1059	20.1086	20.1112	20.1235	20.1258	20.1365	20.1365	20.1385	20.1324	20.1258	20.1211	20.1163	(88)
util rest of house	0.9984	0.9972	0.9924	0.9689	0.8754	0.6624	0.4618	0.5285	0.8414	0.9812	0.9966	0.9987	(89)
MIT 2	18.6911	18.8377	19.1326	19.5701	19.9338	20.1095	20.1338	20.1328	20.0257	19.5808	19.0793	18.6797	(90)
Living area fraction									fLA = Living area / (4) =			0.5262	(91)
MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3534	19.4749	19.7204	20.0841	20.3969	20.5578	20.5861	20.5825	20.4744	20.0910	19.6729	19.3411	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9965	0.9913	0.9685	0.8874	0.7032	0.5181	0.5864	0.8652	0.9809	0.9960	0.9984	(94)
Useful gains	398.7893	427.2471	461.4329	500.4412	496.1381	390.1029	271.7657	281.8365	373.1241	384.2713	376.9698	382.7761	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1077.2347	1039.5922	939.9523	783.1573	607.2453	410.4182	274.5908	287.3986	441.4121	662.6920	882.9966	1069.7980	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating												2641.1255	(98)
Space heating per m2											(98) / (4) =	35.9093	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

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Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2827.7575	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.7634	411.4959	356.0184	203.5556	82.6637	0.0000	0.0000	0.0000	0.0000	207.1450	364.3393	511.1443	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	540.4319	440.5737	381.1761	217.9396	88.5050	0.0000	0.0000	0.0000	0.0000	221.7826	390.0849	547.2637	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.2048	171.3900	178.3202	158.1610	153.1278	134.8664	129.2123	144.0414	145.6322	165.8312	177.0216	191.5972	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3256	87.1759	86.7583	85.6875	83.5735	80.3000	80.3000	80.3000	80.3000	85.6123	86.8288	87.4027	(217)
Fuel for water heating, kWh/month													
	224.6819	196.6024	205.5367	184.5789	183.2253	167.9531	160.9119	179.3791	181.3601	193.7003	203.8742	219.2119	(219)
Water heating fuel used												2301.0157	(219)
Annual totals kWh/year													
Space heating fuel - main system												2827.7575	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												357.9054	(232)
Total delivered energy for all uses												5561.6786	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2827.7575	0.2160	610.7956	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2301.0157	0.2160	497.0194	(264)
Space and water heating			1107.8150	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	357.9054	0.5190	185.7529	(268)
Total CO2, kg/m2/year			1332.4929	(272)
Emissions per m2 for space and water heating			15.0621	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5255	(272b)
Emissions per m2 for pumps and fans			0.5292	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0621 * 1.00) + 2.5255 + 0.5292, rounded to 2 d.p.			18.1200	(273)