Energy and Sustainability Report

Proposed Replacement 5 Bedroom Detached House,

38 Frognal Lane, London NW3 6PP

Proposed Street View Elevation

February 2020

Client: Fitzpatrick Construction Ltd

Prepared by

MONITOR energy consultancy

accredited SAP assessors

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1.0 INTRODUCTION

1.1 Brief

Monitor Energy Consultancy has been instructed by Fitzpatrick Construction Ltd, to undertake an Energy report to establish the carbon footprint of the proposed replacement dwelling at 38 Frognal Lane NW3 6PP and to compare this with that of the existing house if refurbished to modern standards.

The new dwelling aims to achieve "exemplary sustainability", to maximise energy efficiency and reduce carbon emissions through passive and active energy conservation methods while providing a viable and deliverable solution. The proposals would be designed to greatly exceed the London Borough of Camden's energy reduction target to reduce carbon dioxide emissions by at least 19% compared with Building Regulations 2013 Part L1A requirements.

1.2 Existing House

The existing house was originally constructed in the 1890s and was substantially re-modelled in the 1930s. It has very poor energy efficiency, having no floor, wall or roof insulation, old fashioned double glazing and building services that could be upgraded with more energy efficient alternatives.

The existing dwelling has been modelled using SAP 2012 to establish the current carbon emission rate both as it stands, and what could be achieved if it was refurbished within the bounds of viability, without the need to demolish and re-build.

Total Area GIA	**Dwelling Emission rate (DER) (CO_2 kg/m2/yr)**	**Total CO_2 (kg/yr)**
194.33	69.45	13 496.22

Existing House Emission rate - SAP results 2012 for existing dwelling.

The Dwelling Emission rate (DER) of the existing house as it stands, taking into account the total regulated CO_2 emissions due to heating, hot water, pumps and fans and lighting for the house as existing has been calculated as **13 496.22 kg/yr.** The full SAP calculations confirming the DER can be found in **Appendix A.**

Whilst there is no actual requirement to undertake any work to improve the existing property, if it was to be refurbished to modern standards, the following improvement measures could reasonably be implemented:

- Insulate flat ceiling below sloping roof area to modern standard U value of 0.16W/m2K. (Flat roof and sloping ceiling would not feasible area without demolishing and replacing ceilings),
- Insulate cavity wall areas retrospectively, (solid brick walls would not be feasible without removing existing internal fittings)
- Replace all windows and conservatory roof with modern standard glazing,
- Install new boiler to modern standard with improved heating controls,
- Change all lights to low energy,

The consequential DER that could be achieved by incorporating these improvements has been calculated as below.

Total Area GIA	**Dwelling Emission rate (DER) (CO_2 kg/m2/yr)**	**Total CO_2 (kg/yr)**
194.33	42.18	8 196.84

Existing House Emission rate - SAP results 2012 for existing dwelling after refurbishment.

The total regulated CO_2 emissions for the existing house, following refurbishment, would be **8,196.84 kg/yr.** The full SAP calculations confirming the DER can be found in **Appendix A.**

1.3 Proposed Development

The proposed development comprises the demolition of the existing dwelling and erection of a replacement dwelling incorporating changes approved under 2018/5502/P dated 04/02/2019 (for two storey rear extensions, first floor side extensions, installation of three dormer windows to the front elevation and one to the rear elevation, conversion of garage into habitable use and alterations to openings) as well as lowering of first floor windows on front elevation.

Partial demolition and re-construction has also been considered but this would not be able to achieve the same level of energy efficiency as a total new build, as aspects such as air tightness and careful detailing to reduce heat loss due to thermal bridging at existing junctions such as window openings can not be achieved to the same standard.

2.0 ENERGY EFFICIENCY

2.1 Approach

The Clients approach to sustainable development is to first optimise the energy efficiency of the building to be better than current requirements of the Building Regulations. Secondly to ensure energy is supplied to the development as efficiently as possible and thirdly to incorporate renewable energy technology where viable. This follows the most recognised method of achieving sustainability, the Mayor of London's Energy Hierarchy (*summarised as 'be Lean, be Clean, be Green'*)

- Use less energy (be lean).
- Supply energy efficiently (be clean).
- Use renewable energy (be green).

This appraisal demonstrates that by adopting the above approach a reduction in carbon emissions well in excess of 19% compared to the current 2013 Building Regulations will be achieved for the regulated emissions from this development.

A detailed appraisal of all practical renewable technologies has been undertaken and in this instance the use of passive and energy efficient measures has been adopted for the development together with photovoltaic panels on the roof. The primary advantages of this method are as follows:

- Fabric first approach to ensure the thermal elements are insulated to a high standard in the first instance.
- Additional carbon savings provided by the incorporation of proven efficient technologies with limited requirements for future maintenance.
- Further offset of carbon emissions by the addition of photovoltaic panels.

This appraisal demonstrates that by the adoption of the strategy of incorporating energy efficient measures including good insulation, an air source heat pump with sophisticated controls and photovoltaic panels, an overall reduction in CO_2 emissions of **2,904 kg CO_2/yr** can be achieved which represents a **35.31%** reduction in regulated emissions, in excess of the London Borough of Camden's Planning requirements.

The energy performance of the proposed dwelling has been assessed for the base line requirement of compliance with Part L1B of the 2013 Building Regulations to demonstrate the standard required to meet minimum Building Regulations for energy.

The potential benefits of additional passive and low energy efficiency measures have been proportionally assessed together with the further improvements that can be achieved using low and zero carbon technologies in order to achieve more than the 19% carbon off-set required by the London Borough of Camden.

In this instance both passive and active energy efficient measures have been adopted as the main approach to achieve this target. Specific commitments and key measures to achieve the target CO_2 reductions include:

- A fabric first approach to ensure the thermal elements are insulated to a high standard in the first instance using enhanced standards of insulation for the floors, walls and roofs and high-performance double-glazed windows and doors.
- Low air leakage rates.
- High standard detailing to minimise heat loss due to thermal bridging at junctions.
- Heating provided via an electric air source heat pump with advanced zone controls.
- 100% low energy lighting.
- Smart meters and energy efficient appliances.
- Incorporation of proven and well recognised technologies with limited requirements for future maintenance.
- Discretely positioned photovoltaic panels on the central/flat roof area where they would not be seen.

The basic approach for the energy strategy is as follows:

1. To establish the baseline energy demand to ensure that the Standard Case dwelling carbon emission rates meet compliance with the statutory requirements of the Building Regulations 2013 Part L1A. The dwellings have all been modelled using SAP 2012, with the TER (Target Emission Rate) calculated. The results of this assessment together with the calculated target CO2 emissions to be achieved are shown in **Section 2.2**

2. Following the '*Be Lean*' principle, passive design and efficiency measures were considered first to optimise the reduction of energy use within the development. These are described in **Section 2.3**

3. Localised and decentralised energy networks such as combined heat and power (CHP) or community/district heating schemes were considered to meet the '*Be Clean*' requirement, and this is described in **Section 2.4.**

4. The potential viability of six low and zero carbon technologies were considered for integration within the proposed development as part of the '*Be Green*' stage and the feasibility assessments are described in **Section 2.5**

5. The actual energy demand for the dwellings as proposed has been calculated, to include the enhanced thermal and mechanical services specification and incorporate those options deemed most suitable from the result of the above considerations by calculating the actual DER (Dwelling Emission Rate). The regulated loads for each dwelling for both TERs and DERS have been calculated and tabulated in **Section 2.6**

2.2 Standard Case Energy Demand Assessment (TER) and establishing Target CO_2 Emissions

The dwelling has been modelled using SAP 2012 to establish both the Standard Case TER (Target Emission Rate) required to meet Building Regulations ADL1A 2013 compliance for CO2 emissions and the Actual case DER (Dwelling Emission Rate) of the dwelling as proposed. The standard Case TER has been calculated as below.

Total Area GIA	Standard Case TER (CO_2 kg/m2/yr)	Total CO_2 (kg/yr)
426.48	19.28	8 222.53

Standard (Notional) Case SAP results 2012 (TER) for new dwelling.

The total regulated CO_2 emissions due to heating, hot water, pumps and fans and lighting for the development if built to Building Regulations Part L1A standard would be **8,222.53 kg/yr.** The full SAP calculations confirming the TER can be found in **Appendix B.**

This figure has been used to calculate the 19% carbon off-set required and therefore the maximum CO_2 emissions to be achieved to satisfy the London Borough of Camden's planning requirement. The figures calculated are illustrated in the summary below.

	Kg CO_2/yr
Building Regulations Compliant case (TER)	8 222.53
Minimum 19% target reduction of Standard case Emissions	1 562.28
Maximum CO_2 emissions to be achieved	**6 660.25**

CO_2 emissions for Building Regulations Standard Case used to derive the 19% reduction required and to set the standard for achieving the planning requirement.

The Building Regulations Compliant case has been calculated at 8,222.53 kg CO_2/yr. The calculated minimum 19% reduction in CO_2 required = 8,222.53 x 0.19= 1,562.28 kg CO_2/yr. The overall maximum CO_2 emissions to be achieved for the development is 8,222.53 – 1,562.28 = **6,660.25 kg CO_2/yr.**

2.3 Actual "BE LEAN" Case Energy Demand Assessment

For the actual proposed case, the following improvements have been incorporated in order to reduce energy demand:

Element	Building Regulations standard	Proposed
Ground floor U value	0.22 W/m2K	0.11 W/m2K
External walls U value	0.28 W/m2K	Fair faced brick walls 0.18 W/m2K Dormer walls 0.18 W/m2K
Roof (sloping ceiling)	0.18 W/m2K	0.13 W/m2K
Flat roofs	0.18 W/m2K	0.13 W/m2K
Windows and doors	1.6 W/m2K	1.2 W/m2K
Air permeability rate	10.0m3/hm2 (@50Pa)	4.0m3/hm2 (@50Pa)
Thermal bridging y value	0.15	0.05 approx
Air source heat pump efficiency	100%	100%
Controls	Programmer, thermostat and TRVs	Time and temperature zone controls for separate rooms
Energy efficient lighting	75% of lights	100% of lights

Fabric Efficiency improvements

- Improved U values of 0.11 W/m2K for the ground floor using 150mm Kingspan K3 floorboard or similar.
- Improved U values of 0.18 W/m2K for the brick walls eg using 90mm Kingspan K106 cavity board and lightweight Aircrete blocks with plasterboard dry lining.
- Improved U values of 0.18W/m2K for dormer cheeks using 100mm Kingspan K12 insulation within studwork and 47.5mm Kingspan K118 insulated plasterboard dry lining.
- Improved U-value of 0.13 W/m2K for sloping roofs using 100mm Kingspan K7 insulation between rafters plus 62.5mm Kingspan K118 insulated plasterboard dry lining.
- Improved U-value of 0.13 W/m2K for flat roofs using 175mm Kingspan TR27 insulation above joists.
- All windows and external doors to be high-performance double-glazed low E, with 16mm minimum gap, argon filled to achieve a U value of 1.2 W/m2K.
- Hi-therm lintels to minimise heat loss at this junction.
- Standard accredited thermal bridging details or better to be adopted for all other junctions where available to ensure insulation is fully overlapped to reduce thermal bridging.
- All junctions in construction to be well sealed to achieve an air permeability rate of 4 or lower.

Additional Energy efficiency measures

- Air source heat pump to provide space and water heating.
- Energy efficient hot water cylinder with low measured heat loss.
- 100% low energy lighting.

The dwelling has been modelled incorporating the improvements detailed above and the actual proposed DER (Dwelling Emission Rate) has been calculated and is shown below. The full SAP calculations confirming the DER can be found in **Appendix B.**

Total Area GIA	Actual Case DER (CO_2 kg/m2/yr)	Total CO_2 (kg/yr)
426.48	15.25	6 503.82

Actual Case SAP results 2012 (DER) for new dwelling with "BE LEAN" passive energy efficiency measures .

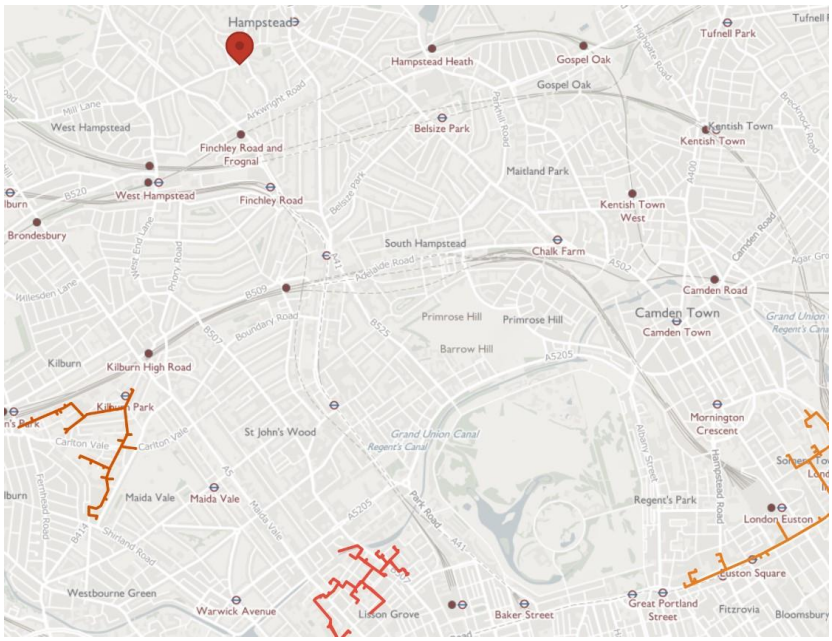
The total regulated CO_2 emissions for the development if built including the improvements listed above would be reduced to **6, 503.82 kg/yr**.

This represents a reduction of 8 222.53 – 6 503.82 = **1,718.71 kg CO_2/yr** which is a **20.89%** reduction of CO_2 emissions compared with current 2013 Building Regulations and less than the maximum allowed emissions of **6,660.25 kg CO2/yr.** **The Development therefore complies with the London Borough of Camden's Energy reduction target.**

It is proposed however to go beyond this requirement, therefore consideration has been given to further measures that could be adopted using the "Be Clean" and "Be Green" stages of the Energy Hierarchy.

2.4 Actual "BE CLEAN" Case Energy Demand Assessment

The feasibility of connecting into an existing heating network has been assessed alongside the London Heat Map Study for the London Borough of Camden. The study identifies that the site is not located within a viable distance of the existing or potential district heating networks.



The Energy Hierarchy identifies combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. For maximum efficiency, a CHP system needs to operate for at least 5000 hours/year and requires a heat sink, a consistent base heating load requirement throughout the year where the waste heat from the electrical generation may be used constantly and efficiently while simultaneously providing electricity for the site. It is therefore more appropriate for hospitals, hotels etc where demand is consistent. Domestic dwellings have variable

occupation patterns resulting in inconsistent heating and electrical demand. For a development of this size and scale, it would not be appropriate to provide a new CHP plant.

For the above reasons, it has not been possible to reduce carbon emissions at this stage of the hierarchy.

2.5 Actual "BE GREEN" Case Energy Demand Assessment

In this section, the viable renewable technologies that could further reduce the developments CO2 emissions have been considered. Six potential renewable energy technologies were considered for integration within the proposed development. Feasibility is based on location, space limitations, cost and payback for both initial payment and ongoing maintenance and suitability. In conclusion, both PV panels and an air source heat pump have been considered as suitable for adoption for this development.

2.5.1 Photovoltaic cells

There is an opportunity to discretely install photovoltaic cells on the central flat and sloping roofs of the property. Four frame mounted units (0.8m x 4.2m each) could be located on the central flat roof area together with three panels (0.7m x 7.5m in total) on the central South East facing roof which could provide a total of 2.8 kWp of PV .

2.5.2 Solar Water Heating

The development also has the potential to use solar water heating with panels located on the flat roof areas although these would therefore be competing for the same space as the PV panels and would not be able to achieve as much carbon reduction as PV, however these can also be considered in the future.

2.5.3 Ground Source Heat pump

Approximately 10m of trench for slinky pipes would be required to obtain 1kW output of heating. For a small to average heat pump of 6kW this would require 60m for each unit, a total of 1560m, therefore there would not be adequate space on the site for this option. The alternative method involving drilling a borehole would be extremely expensive and not generally considered a feasible option for small scale domestic applications.

2.5.4 Air Source Heat Pump

With current ideology in favour of moving away from traditional fossil fuels for energy supply, an electric air source heat pump has already been proposed at the "Be Lean" stage to provide space and water heating.

2.5.5 Wind

Wind turbines are only appropriate where the average wind velocity is in excess of 6m/s. The DECC wind speed database estimates the average wind speed in this location is less than 4.07m/s at an average height of 20m above ground level which would not create a viable supply of energy. In addition, a wind turbine would be both visually and audibly intrusive and not suitable for this small site where there is insufficient space to accommodate it. This option has therefore been discarded.

2.5.6 Biomass

Biomass boilers would require increased management, maintenance and space for both a central energy plant room and biomass store. In addition, there would be a requirement for biomass deliveries via heavy vehicles, therefore it is considered that this site and its location are not suitable for fuel delivery, storage or local supply. This option has therefore been discarded.

2.6 Proposed Scheme

For the BE GREEN stage of the assessment, the low and zero carbon technology proposed for this project is for an array of photovoltaic panels providing 2.8 kWp of PV panels in addition to an air source heat pump to further reduce CO2 emissions. The results of adding this to the proposals already considered are illustrated below. The full SAP calculations confirming the DER can be found in **Appendix B.**

Total Area GIA	Actual Case DER (CO_2 kg/m2/yr)	Total CO_2 (kg/yr)
426.48	12.47	5 318.20

Actual Case SAP results 2012 (DER) for new dwelling with "BE GREEN" renewable energy efficiency measures .

The total regulated CO_2 emissions for the development if built including the improvements listed above would be reduced to **5 318.20 kg/yr**.

This represents a reduction of 8 222.53 – 5 318.20 = **2 904.33 kg CO_2/yr** which is a **35.31%** reduction of CO_2 emissions compared with current 2013 Building Regulations and when compared with the existing house if refurbished, a saving of 8196.84 – 5318.20 = **2 878.64 kg CO_2/yr.**

2.7 CONCLUSIONS

The total carbon emissions for the proposed development after each stage of the domestic Energy Hierarchy are tabulated below

		Regulated Carbon Dioxide Emissions (Tonnes CO2/yr)
A	Baseline: Part L1B 2013 of the Building Regulations Compliant Development	8 222.53
B	After energy demand reduction due to passive energy efficiency measures	6 503.82
C	After low carbon heating system installed	6 503.82
D	After renewable energy	5318.20

Carbon Dioxide Emissions after each stage of the Energy Hierarchy

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per yr)	**(%)**
Savings from energy demand reduction **(A-B)**	1.719	20.89
Savings from heat network/CHP **(B-C)**	0	0
Savings from renewable energy **(C-D)**	1.185	14.42
Cumulative On Site Savings	**2.904**	**35.31**

Carbon Dioxide Emissions savings after each stage of the Energy Hierarchy

This report identifies how **35.31** % of regulated carbon emissions for which this development is responsible, are proposed to be off-set by various energy efficiency measures compared to a Building Regulations Part L1A 2013 compliant scheme.

The analysis has shown that by incorporating energy efficient construction and installations, there is a significant reduction in the development CO_2 emissions based on the SAP calculation method. The potential on-site low and zero carbon technologies have

also been assessed taking into account the scale of this particular development and constraints such as location, visual impact, preventing additional vehicle movements and local pollution concerns.

The scheme therefore demonstrates a significant reduction in carbon emissions compared with both the existing house if it was to be refurbished and the London Borough of Camden Planning requirements for new build dwellings.

3. WATER CONSERVATION

Water efficient sanitary and kitchen fittings are proposed to achieve the water efficiency target of 110 litres/person/day which demonstrates a commitment to water conservation. These include:

- Low water use taps and shower fittings
- Dual flush WCs with low flush volumes
- Baths with lower volume capacity
- Water efficient kitchen appliances

Rainwater harvesting is proposed to provide water supply for WCs and garden use.

Water usage calculations have been prepared which demonstrate that the proposed house will use 104 litres /person/day. The calculations can be found in **Appendix C**

4.0 MATERIALS

The waste materials from any demolition of the existing structures will be re-used where possible and the remainder sent for recycling and not to landfill.

New materials with low embodied carbon will be used wherever possible, with the aim to minimise the materials used, reduce waste and energy and water use during construction.

5.0 ADAPTATION TO CLIMATE CHANGE

This report has demonstrated this proposed development shows a commitment to:

- Minimise the carbon footprint by replacing an energy inefficient building with a highly efficient low energy building using energy efficient heating, ventilation, lighting and appliances to achieve a **35.31%** reduction in CO_2 emissions over that required by Building Regulations 2013.

- Ensure there is no excessive summer overheating risk as summer overheating levels have been calculated in the SAP calculations to these check that there will be no unacceptable overheating risk and no air conditioning will be needed.
- Offset carbon emissions through the provision of on-site renewable technology in the form of PV panels.
- Minimise water consumption through the use of rainwater recycling and low water use fittings
- Reduce surface water run off with soft landscaping and rainwater harvesting.
- Use of sustainable construction methods using materials with low embodied energy from renewable sources which also minimise on site waste.

In conclusion, the proposed development will achieve best practice sustainability standards with regard to energy, water conservation and adaptation to climate change.

APPENDIX A - SAP 2012 CALCULATIONS FOR THE DWELLING AS EXISTING AND IF REFURBISHED.

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

Design SAP
elmhurst energy

Property Reference	022002	**Issued on Date**	07/02/2020
Assessment Reference	existing house	**Prop Type Ref**	
Property	38, Frognal Lane, London, NW3 6PP		

SAP Rating	44 E	**DER**	69.45	**TER**	16.31
Environmental	34 F	**% DER<TER**	-325.85		
CO_2 Emissions (t/year)	11.66	**DFEE**	233.23	**TFEE**	65.48
General Requirements Compliance	Fail	**% DFEE<TFEE**	-256.17		

Assessor Details	Mrs. Nicola Battista, Monitor Energy Consultancy, Tel: 01752830291, nicola@monitor-ec.co.uk	**Assessor ID**	L706-0001
Client			

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

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

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DWELLING AS DESIGNED

Detached House, total floor area 194 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) 16.31 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 69.45 kgCO□/m²Fail
Excess emissions =53.14 kgCO□/m² (326.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)233.2 kWh/m²/yrFail
Excess energy =167.7 kWh/m²/yr (256.0%)

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2 Fabric U-values

Element	Average	Highest	
External wall	1.81 (max. 0.30)	2.10 (max. 0.70)	Fail
Floor	0.76 (max. 0.25)	0.76 (max. 0.70)	Fail
Roof	2.30 (max. 0.20)	2.30 (max. 0.35)	Fail
Openings	3.19 (max. 2.00)	3.40 (max. 3.30)	Fail

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

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3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Post 98 Regular condens. with auto ign.

SAP default data Fail

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Nominal cylinder loss: 3.36 kWh/day
Permitted by DBSCG 2.86 Fail
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Programmer, TRVs and bypass Fail

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock No Fail

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:16%
Minimum 75% Fail

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.08 m², No overhang
Windows facing South East: 18.79 m², No overhang
Windows facing South West: 0.55 m², No overhang
Windows facing North West: 18.79 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
None

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	112.4000 (1b)	x	2.7800 (2b)	=	312.4720	(1b) - (3b)
First floor	81.9300 (1c)	x	3.1100 (2c)	=	254.8023	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	194.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	567.2743	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0705	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8205	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7590	(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	0.9677	0.9487	0.9297	0.8349	0.8159	0.7210	0.7210	0.7021	0.7590	0.8159	0.8538	0.8918	(22b)
Effective ac	0.9682	0.9500	0.9322	0.8485	0.8328	0.7599	0.7599	0.7464	0.7880	0.8328	0.8645	0.8976	(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	
Opening Type 1			2.0400	3.0000	6.1200			(26)
Opening Type 2 (Uw = 3.10)			45.2100	2.7580	124.6895			(27)
Opening Type 3 (Uw = 3.40)			21.5000	2.9930	64.3486			(27a)
Heat Loss Floor 1			112.4000	0.7600	85.4240			(28a)
External Wall 1	103.9700	13.9700	90.0000	2.1000	189.0000			(29a)
External Wall 2	156.8000	33.2800	123.5200	1.6000	197.6320			(29a)
External Roof 1	28.2500		28.2500	2.3000	64.9750			(30)
External Roof 2	20.4300		20.4300	2.3000	46.9890			(30)
External Roof 3	39.3800		39.3800	2.3000	90.5740			(30)
External Roof 4	29.9800	21.5000	8.4800	2.3000	19.5040			(30)
External Roof 5	3.6500		3.6500	2.3000	8.3950			(30)
Total net area of external elements Aum(A, m2)			494.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	897.6511			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	74.2290	(36)
Total fabric heat loss (33) + (36) =	971.8801	(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	181.2502	177.8466	174.5105	158.8406	155.9089	142.2609	142.2609	139.7336	147.5179	155.9089	161.8398	168.0403	(38)
Heat transfer coeff	1153.1303	1149.7267	1146.3905	1130.7207	1127.7890	1114.1410	1114.1410	1111.6137	1119.3980	1127.7890	1133.7199	1139.9204	(39)
Average = Sum(39)m / 12 =												1130.7067	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	5.9339	5.9164	5.8992	5.8186	5.8035	5.7332	5.7332	5.7202	5.7603	5.8035	5.8340	5.8659	(40)
HLP (average)												5.8185	(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	2.9945 (42)
Average daily hot water use (litres/day)	110.8635 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.9498	117.5153	113.0807	108.6462	104.2117	99.7771	99.7771	104.2117	108.6462	113.0807	117.5153	121.9498	(44)
Energy conte	180.8480	158.1709	163.2182	142.2975	136.5379	117.8218	109.1792	125.2848	126.7811	147.7511	161.2819	175.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1744.3140	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m													
	27.1272	23.7256	24.4827	21.3446	20.4807	17.6733	16.3769	18.7927	19.0172	22.1627	24.1923	26.2713	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.8125	(55)
Total storage loss													
	56.1888	50.7512	56.1888	54.3763	56.1888	54.3763	56.1888	56.1888	54.3763	56.1888	54.3763	56.1888	(56)
If cylinder contains dedicated solar storage													
	56.1888	50.7512	56.1888	54.3763	56.1888	54.3763	56.1888	56.1888	54.3763	56.1888	54.3763	56.1888	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	260.2993	229.9333	242.6694	219.1858	215.9891	194.7101	188.6305	204.7360	203.6694	227.2023	238.1702	254.5929	(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													
	260.2993	229.9333	242.6694	219.1858	215.9891	194.7101	188.6305	204.7360	203.6694	227.2023	238.1702	254.5929	(64)
								Total per year (kWh/year) = Sum(64)m =				2679.7883	(64)
Heat gains from water heating, kWh/month													
	123.6930	110.0017	117.8310	108.8246	108.9598	100.6864	99.8631	105.2182	103.6653	112.6882	115.1369	121.7956	(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	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9760	53.2702	43.3222	32.7977	24.5167	20.6980	22.3649	29.0708	39.0187	49.5433	57.8243	61.6430	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.6243	369.4184	359.8575	339.5036	313.8104	289.6625	273.5302	269.7361	279.2970	299.6509	325.3441	349.4920	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	(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)													
	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	(71)
Water heating gains (Table 5)													
	166.2540	163.6931	158.3750	151.1452	146.4514	139.8422	134.2246	141.4223	143.9796	151.4627	159.9123	163.7038	(72)
Total internal gains													
	662.7724	657.2997	632.4729	594.3646	555.6966	521.1208	501.0378	511.1473	533.2134	571.5749	613.9987	645.7568	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.7600	0.7000	0.7700	29.4510	(75)
Southeast	18.7900	36.7938	0.7600	0.7000	0.7700	254.8864	(77)
Southwest	0.5500	36.7938	0.7600	0.7000	0.7700	7.4608	(79)
Northwest	18.7900	11.2829	0.7600	0.7000	0.7700	78.1617	(81)
Southeast	21.5000	26.0000	0.7600	0.7000	1.0000	267.6492	(82)

Solar gains	637.6091	1221.8099	1994.3324	2949.8640	3696.2819	3830.0922	3626.6904	3053.2039	2326.7803	1441.0035	789.3447	528.5747	(83)
Total gains	1300.3815	1879.1096	2626.8052	3544.2286	4251.9785	4351.2130	4127.7282	3564.3512	2859.9938	2012.5784	1403.3434	1174.3315	(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	11.7030	11.7377	11.7719	11.9350	11.9660	12.1126	12.1126	12.1401	12.0557	11.9660	11.9034	11.8387	
alpha	1.7802	1.7825	1.7848	1.7957	1.7977	1.8075	1.8075	1.8093	1.8037	1.7977	1.7936	1.7892	
util living area													
	0.9923	0.9847	0.9685	0.9329	0.8725	0.7872	0.6976	0.7525	0.8882	0.9649	0.9881	0.9936	(86)
MIT	16.4142	16.7397	17.3931	18.3184	19.2451	20.0334	20.4724	20.3648	19.6517	18.4663	17.2916	16.3758	(87)
Th 2	18.0004	18.0006	18.0008	18.0027	18.0032	18.0059	18.0059	18.0065	18.0048	18.0032	18.0023	18.0015	(88)
util rest of house													
	0.9892	0.9785	0.9545	0.8982	0.7908	0.5991	0.3357	0.4174	0.7688	0.9401	0.9821	0.9911	(89)
MIT 2	14.2964	14.6191	15.2654	16.1653	17.0334	17.6960	17.9588	17.9287	17.4397	16.3315	15.1687	14.2554	(90)
Living area fraction										fLA = Living area / (4) =		0.1731	(91)
MIT	14.6629	14.9861	15.6336	16.5379	17.4161	18.1005	18.3938	18.3503	17.8225	16.7009	15.5361	14.6224	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.6629	14.9861	15.6336	16.5379	17.4161	18.1005	18.3938	18.3503	17.8225	16.7009	15.5361	14.6224	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9828	0.9671	0.9351	0.8701	0.7658	0.6081	0.4068	0.4795	0.7560	0.9198	0.9726	0.9856	(94)
Useful gains	1277.9893	1817.2949	2456.4059	3083.8624	3256.1281	2646.0592	1678.9608	1708.9516	2162.0632	1851.1858	1364.8493	1157.4663	(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													
	11949.8033	11596.2294	10470.6648	8636.2989	6446.5862	3900.0467	1998.5526	2167.9541	4166.9710	6880.5734	9564.1199	11880.6962	(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													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	7939.8296	6571.4440	5962.6086	3997.7543	2373.7008	0.0000	0.0000	0.0000	0.0000	3741.8644	5903.4749	7978.0830	(98)
Space heating												44468.7596	(98)
Space heating per m2											(98) / (4) =	228.8312	(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)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												79.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												56289.5691	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	7939.8296	6571.4440	5962.6086	3997.7543	2373.7008	0.0000	0.0000	0.0000	0.0000	3741.8644	5903.4749	7978.0830	(98)
Space heating efficiency (main heating system 1)													
	79.0000	79.0000	79.0000	79.0000	79.0000	0.0000	0.0000	0.0000	0.0000	79.0000	79.0000	79.0000	(210)
Space heating fuel (main heating system)													
	10050.4172	8318.2836	7547.6058	5060.4485	3004.6846	0.0000	0.0000	0.0000	0.0000	4736.5372	7472.7530	10098.8393	(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													
	260.2993	229.9333	242.6694	219.1858	215.9891	194.7101	188.6305	204.7360	203.6694	227.2023	238.1702	254.5929	(64)
Efficiency of water heater												69.0000	(216)
(217)m	78.6382	78.6148	78.5548	78.4093	78.0565	69.0000	69.0000	69.0000	69.0000	78.3500	78.5585	78.6475	(217)
Fuel for water heating, kWh/month													
	331.0086	292.4808	308.9174	279.5405	276.7087	282.1886	273.3775	296.7188	295.1730	289.9839	303.1756	323.7139	(219)
Water heating fuel used												3552.9873	(219)
Annual totals kWh/year													
Space heating fuel - main system												56289.5691	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												39.0000	(230c)
Total electricity for the above, kWh/year												39.0000	(231)
Electricity for lighting (calculated in Appendix L)												1059.1956	(232)
Total delivered energy for all uses												60940.7521	(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	56289.5691	0.2160	12158.5469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	3552.9873	0.2160	767.4453	(264)
Space and water heating			12925.9922	(265)
Pumps and fans	39.0000	0.5190	20.2410	(267)
Energy for lighting	1059.1956	0.5190	549.7225	(268)
Total CO2, kg/year			13495.9557	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			69.4500	(273)

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

DER		69.4500	ZC1
Total Floor Area	TFA	194.3300	
Assumed number of occupants	N	2.9945	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.1491	ZC2
CO2 emissions from cooking, equation (L16)		0.9822	ZC3
Total CO2 emissions		81.5813	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		81.5813	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	112.4000 (1b)	x	2.7800 (2b)	=	312.4720	(1b) - (3b)
First floor	81.9300 (1c)	x	3.1100 (2c)	=	254.8023	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	194.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	567.2743	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0705	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3205	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2965	(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	0.3780	0.3706	0.3632	0.3261	0.3187	0.2817	0.2817	0.2742	0.2965	0.3187	0.3335	0.3484	(22b)
Effective ac	0.5714	0.5687	0.5660	0.5532	0.5508	0.5397	0.5397	0.5376	0.5439	0.5508	0.5556	0.5607	(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			2.0400	1.0000	2.0400			(26)
TER Opening Type (Uw = 1.40)			31.5400	1.3258	41.8144			(27)
TER Room Window (Uw = 1.70)			15.0000	1.5918	23.8764			(27a)
Heat Loss Floor 1			112.4000	0.1300	14.6120			(28a)
External Wall 1	103.9700	10.3600	93.6100	0.1800	16.8498			(29a)
External Wall 2	156.8000	23.2200	133.5800	0.1800	24.0444			(29a)
External Roof 1	28.2500		28.2500	0.1300	3.6725			(30)
External Roof 2	20.4300		20.4300	0.1300	2.6559			(30)
External Roof 3	39.3800		39.3800	0.1300	5.1194			(30)
External Roof 4	29.9800	15.0000	14.9800	0.1300	1.9474			(30)
External Roof 5	3.6500		3.6500	0.1300	0.4745			(30)
Total net area of external elements Aum(A, m2)			494.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	137.1067			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		24.7430 (36)
Total fabric heat loss	(33) + (36) =	161.8497 (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	106.9746	106.4552	105.9462	103.5551	103.1078	101.0253	101.0253	100.6396	101.8274	103.1078	104.0128	104.9589	(38)
Heat transfer coeff	268.8243	268.3049	267.7959	265.4048	264.9575	262.8750	262.8750	262.4893	263.6771	264.9575	265.8625	266.8086	(39)
Average = Sum(39)m / 12 =												265.4027	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3833	1.3807	1.3780	1.3657	1.3634	1.3527	1.3527	1.3507	1.3569	1.3634	1.3681	1.3730	(40)
HLP (average)												1.3657	(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	2.9945 (42)
Average daily hot water use (litres/day)	105.3203 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.8523	111.6395	107.4267	103.2139	99.0011	94.7883	94.7883	99.0011	103.2139	107.4267	111.6395	115.8523	(44)
Energy conte	171.8056	150.2623	155.0572	135.1827	129.7110	111.9307	103.7203	119.0205	120.4420	140.3635	153.2178	166.3846	(45)
Energy content (annual)										Total = Sum(45)m =		1657.0983	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
              25.7708    22.5393    23.2586    20.2774    19.4566    16.7896    15.5580    17.8531    18.0663    21.0545    22.9827    24.9577 (46)
Water storage loss:
Store volume                                                                                                                            300.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             2.1127 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                1.1409 (55)
Total storage loss
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             230.4345   203.2174   213.6861   191.9202   188.3398   168.6683   162.3491   177.6493   177.1796   198.9924   209.9553   225.0134 (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
             230.4345   203.2174   213.6861   191.9202   188.3398   168.6683   162.3491   177.6493   177.1796   198.9924   209.9553   225.0134 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =             2347.4053 (64)
Heat gains from water heating, kWh/month
             104.0284    92.3263    98.4596    90.3383    90.0320    82.6070    81.3900    86.4774    85.4370    93.5739    96.3350   102.2259 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              32.5957    28.9512    23.5447    17.8248    13.3243    11.2489    12.1549    15.7993    21.2058    26.9257    31.4262    33.5016 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             365.6243   369.4184   359.8575   339.5036   313.8104   289.6625   273.5302   269.7361   279.2970   299.6509   325.3441   349.4920 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727 (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)
            -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815 (71)
Water heating gains (Table 5)
             139.8232   137.3903   132.3382   125.4698   121.0107   114.7320   109.3952   116.2330   118.6625   125.7714   133.7986   137.4004 (72)
Total internal gains
             608.9612   606.6779   586.6584   553.7164   519.0635   486.5614   465.9983   472.6866   490.0834   523.2661   561.4869   591.3121 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data      factor               W
                                                          W/m2         or Table 6b      or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                4.9400          11.2829           0.6300           0.7000          0.7700          17.0342 (75)
Southeast                               13.1100          36.7938           0.6300           0.7000          0.7700         147.4177 (77)
Southwest                                0.3800          36.7938           0.6300           0.7000          0.7700           4.2730 (79)
Northwest                               13.1100          11.2829           0.6300           0.7000          0.7700          45.2061 (81)
Southeast                               15.0000          26.0000           0.6300           0.7000          1.0000         154.7910 (82)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains   368.7219   706.5661  1153.3284  1705.9367  2137.6131  2215.0032  2097.3705  1765.7052  1345.5915   833.3293   456.4703   305.6676 (83)
Total gains   977.6831  1313.2440  1739.9868  2259.6530  2656.6765  2701.5647  2563.3688  2238.3917  1835.6749  1356.5953  1017.9572   896.9797 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          50.2006    50.2978    50.3934    50.8474    50.9332    51.3367    51.3367    51.4121    51.1805    50.9332    50.7598    50.5798
alpha         4.3467     4.3532     4.3596     4.3898     4.3955     4.4224     4.4224     4.4275     4.4120     4.3955     4.3840     4.3720
util living area
              0.9990     0.9961     0.9831     0.9254     0.7828     0.5914     0.4438     0.5227     0.8116     0.9770     0.9975     0.9993 (86)

MIT          19.3716    19.6032    19.9920    20.4791    20.8211    20.9606    20.9911    20.9825    20.8465    20.3347    19.7542    19.3346 (87)
Th 2          19.7761    19.7782    19.7802    19.7897    19.7915    19.7998    19.7998    19.8013    19.7966    19.7915    19.7879    19.7841 (88)
util rest of house
              0.9986     0.9947     0.9769     0.8992     0.7185     0.4934     0.3265     0.3947     0.7256     0.9647     0.9963     0.9990 (89)
MIT 2         17.6142    17.9538    18.5184    19.2051    19.6313    19.7765    19.7970    19.7950    19.6805    19.0238    18.1819    17.5654 (90)
Living area fraction                                                                                  fLA = Living area / (4) =          0.1731 (91)
MIT          17.9183    18.2393    18.7734    19.4256    19.8372    19.9814    20.0036    20.0005    19.8823    19.2507    18.4540    17.8715 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT  17.9183    18.2393    18.7734    19.4256    19.8372    19.9814    20.0036    20.0005    19.8823    19.2507    18.4540    17.8715 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9976     0.9919     0.9696     0.8894     0.7212     0.5089     0.3469     0.4168     0.7327     0.9567     0.9943     0.9984 (94)
Useful gains 975.3750  1302.6177  1687.0689  2009.7881  1915.9239  1374.9046   889.1663   932.9780  1344.9942  1297.9171  1012.1927   895.5112 (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
             3660.9415  3578.9950  3286.7707  2793.5386  2156.0033  1414.6443   894.7265   945.0943  1524.6602  2292.0555  3018.6006  3647.6837 (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
             1998.0615  1529.7256  1190.1782   564.3004   178.6191     0.0000     0.0000     0.0000     0.0000   739.6389  1444.6137  2047.6163 (98)
Space heating                                                                                                                          9692.7537 (98)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 49.8778 (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)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 10366.5815 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1998.0615	1529.7256	1190.1782	564.3004	178.6191	0.0000	0.0000	0.0000	0.0000	739.6389	1444.6137	2047.6163	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	2136.9641	1636.0701	1272.9178	603.5298	191.0365	0.0000	0.0000	0.0000	0.0000	791.0577	1545.0414	2189.9640	(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	230.4345	203.2174	213.6861	191.9202	188.3398	168.6683	162.3491	177.6493	177.1796	198.9924	209.9553	225.0134	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.2624	89.0990	88.6899	87.5217	84.6729	79.8000	79.8000	79.8000	79.8000	87.9985	88.9859	89.3143	(217)
Fuel for water heating, kWh/month	258.1540	228.0804	240.9362	219.2830	222.4321	211.3638	203.4450	222.6182	222.0295	226.1315	235.9422	251.9344	(219)
Water heating fuel used												2742.3503	(219)

Annual totals kWh/year
Space heating fuel - main system 10366.5815 (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) 575.6498 (232)
Total delivered energy for all uses 13759.5816 (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	10366.5815	0.2160	2239.1816	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2742.3503	0.2160	592.3477	(264)
Space and water heating			2831.5293	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	575.6498	0.5190	298.7622	(268)
Total CO2, kg/m2/year			3169.2165	(272)
Emissions per m2 for space and water heating			14.5707	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.5374	(272b)
Emissions per m2 for pumps and fans			0.2003	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5707 * 1.00) + 1.5374 + 0.2003, rounded to 2 d.p.			16.3100	(273)

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

Design SAP
elmhurst energy

Property Reference	022002	**Issued on Date**	05/02/2020
Assessment Reference	existing house + full refurb	**Prop Type Ref**	
Property	38, Frognal Lane, London, NW3 6PP		

SAP Rating	65 D	**DER**	42.18	**TER**	16.31
Environmental	55 D	**% DER<TER**	-158.64		
CO_2 Emissions (t/year)	7.06	**DFEE**	178.25	**TFEE**	65.48
General Requirements Compliance	Fail	**% DFEE<TFEE**	-172.20		

Assessor Details	Mrs. Nicola Battista, Monitor Energy Consultancy, Tel: 01752830291, nicola@monitor-ec.co.uk	**Assessor ID**	L706-0001
Client			

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

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

Detached House, total floor area 194 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) 16.31 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 42.18 kgCO□/m²Fail
Excess emissions =25.87 kgCO□/m² (159.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)178.2 kWh/m²/yrFail
Excess energy =112.7 kWh/m²/yr (172.0%)
---
2 Fabric U-values

Element	Average	Highest	
External wall	1.17 (max. 0.30)	2.10 (max. 0.70)	Fail
Floor	0.76 (max. 0.25)	0.76 (max. 0.70)	Fail
Roof	1.70 (max. 0.20)	2.30 (max. 0.35)	Fail
Openings	1.64 (max. 2.00)	3.00 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
---
3 Air permeability
Air permeability at 50 pascals: 15.00 (assumed) OK
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 88.0% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 2.85 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.08 m², No overhang
Windows facing South East: 18.79 m², No overhang
Windows facing South West: 0.55 m², No overhang
Windows facing North West: 18.79 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
None

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	112.4000 (1b)	x	2.7800 (2b)	=	312.4720	(1b) - (3b)
First floor	81.9300 (1c)	x	3.1100 (2c)	=	254.8023	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	194.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	567.2743	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0705	(8)
Pressure test		No	
Measured/design AP50		15.0000	
Infiltration rate		0.8205	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7590	(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	0.9677	0.9487	0.9297	0.8349	0.8159	0.7210	0.7210	0.7021	0.7590	0.8159	0.8538	0.8918	(22b)
Effective ac	0.9682	0.9500	0.9322	0.8485	0.8328	0.7599	0.7599	0.7464	0.7880	0.8328	0.8645	0.8976	(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	
Opening Type 1			2.0400	3.0000	6.1200			(26)
Opening Type 2 (Uw = 1.60)			45.2100	1.5038	67.9850			(27)
Opening Type 3 (Uw = 1.60)			21.5000	1.5038	32.3308			(27a)
Heat Loss Floor 1			112.4000	0.7600	85.4240			(28a)
External Wall 1	103.9700	13.9700	90.0000	2.1000	189.0000			(29a)
External Wall 2	156.8000	33.2800	123.5200	0.5000	61.7600			(29a)
External Roof 1	28.2500		28.2500	0.1600	4.5200			(30)
External Roof 2	20.4300		20.4300	2.3000	46.9890			(30)
External Roof 3	39.3800		39.3800	2.3000	90.5740			(30)
External Roof 4	29.9800	21.5000	8.4800	2.3000	19.5040			(30)
External Roof 5	3.6500		3.6500	2.3000	8.3950			(30)
Total net area of external elements Aum(A, m2)			494.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	612.6018			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)		74.2290 (36)
Total fabric heat loss	(33) + (36) =	686.8308 (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	181.2502	177.8466	174.5105	158.8406	155.9089	142.2609	142.2609	139.7336	147.5179	155.9089	161.8398	168.0403	(38)
Heat transfer coeff	868.0809	864.6774	861.3412	845.6714	842.7396	829.0917	829.0917	826.5643	834.3487	842.7396	848.6706	854.8711	(39)
Average = Sum(39)m / 12 =												845.6574	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.4670	4.4495	4.4324	4.3517	4.3366	4.2664	4.2664	4.2534	4.2935	4.3366	4.3672	4.3991	(40)
HLP (average)												4.3517	(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	2.9945 (42)
Average daily hot water use (litres/day)	110.8635 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	121.9498	117.5153	113.0807	108.6462	104.2117	99.7771	99.7771	104.2117	108.6462	113.0807	117.5153	121.9498	(44)
Energy conte	180.8480	158.1709	163.2182	142.2975	136.5379	117.8218	109.1792	125.2848	126.7811	147.7511	161.2819	175.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1744.3140	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m

	27.1272	23.7256	24.4827	21.3446	20.4807	17.6733	16.3769	18.7927	19.0172	22.1627	24.1923	26.2713 (46)

Water storage loss:

Store volume 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.8500 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.5390 (55)

Total storage loss

	47.7090	43.0920	47.7090	46.1700	47.7090	46.1700	47.7090	47.7090	46.1700	47.7090	46.1700	47.7090 (56)

If cylinder contains dedicated solar storage

	47.7090	43.0920	47.7090	46.1700	47.7090	46.1700	47.7090	47.7090	46.1700	47.7090	46.1700	47.7090 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month

	251.8194	222.2741	234.1896	210.9795	207.5093	186.5038	180.1506	196.2562	195.4631	218.7225	229.9639	246.1131 (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

	251.8194	222.2741	234.1896	210.9795	207.5093	186.5038	180.1506	196.2562	195.4631	218.7225	229.9639	246.1131 (64)

Total per year (kWh/year) = Sum(64)m = 2579.9450 (64)

Heat gains from water heating, kWh/month

	116.9091	103.8744	111.0472	102.2595	102.1760	94.1214	93.0792	98.4343	97.1003	105.9044	108.5718	115.0117 (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	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	149.7269	(66)

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

	32.5957	28.9512	23.5447	17.8248	13.3243	11.2489	12.1549	15.7993	21.2058	26.9257	31.4262	33.5016 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	365.6243	369.4184	359.8575	339.5036	313.8104	289.6625	273.5302	269.7361	279.2970	299.6509	325.3441	349.4920 (68)

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

	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727	37.9727 (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)

	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815	-119.7815 (71)

Water heating gains (Table 5)

	157.1359	154.5750	149.2569	142.0271	137.3333	130.7241	125.1065	132.3042	134.8615	142.3446	150.7942	154.5857 (72)

Total internal gains

	626.2740	623.8626	603.5772	570.2736	535.3861	502.5536	481.7096	488.7577	506.2824	539.8392	578.4826	608.4973 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.0800	11.2829	0.7200	0.7000	0.7700	27.9010	(75)
Southeast	18.7900	36.7938	0.7200	0.7000	0.7700	241.4713	(77)
Southwest	0.5500	36.7938	0.7200	0.7000	0.7700	7.0681	(79)
Northwest	18.7900	11.2829	0.7200	0.7000	0.7700	74.0479	(81)
Southeast	21.5000	26.0000	0.7200	0.7000	1.0000	253.5624	(82)

Solar gains	604.0507	1157.5041	1889.3675	2794.6080	3501.7407	3628.5084	3435.8120	2892.5089	2204.3182	1365.1612	747.8002	500.7549	(83)
Total gains	1230.3247	1781.3667	2492.9447	3364.8816	4037.1268	4131.0620	3917.5215	3381.2667	2710.6006	1905.0004	1326.2828	1109.2523	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.5459	15.6071	15.6676	15.9579	16.0134	16.2770	16.2770	16.3268	16.1745	16.0134	15.9015	15.7862	
alpha	2.0364	2.0405	2.0445	2.0639	2.0676	2.0851	2.0851	2.0885	2.0783	2.0676	2.0601	2.0524	
util living area	0.9940	0.9868	0.9701	0.9301	0.8585	0.7558	0.6515	0.7149	0.8773	0.9663	0.9901	0.9952	(86)
MIT	17.0015	17.3286	17.9542	18.8317	19.6632	20.3267	20.6622	20.5724	19.9616	18.8828	17.8055	16.9749	(87)
Th 2	18.1958	18.2003	18.2048	18.2264	18.2306	18.2504	18.2504	18.2542	18.2427	18.2306	18.2222	18.2136	(88)
util rest of house	0.9914	0.9811	0.9561	0.8933	0.7711	0.5667	0.3229	0.4013	0.7528	0.9417	0.9849	0.9931	(89)
MIT 2	13.4527	13.9245	14.8223	16.0594	17.1673	17.9428	18.2041	18.1752	17.6094	16.1681	14.6187	13.4134	(90)

Living area fraction fLA = Living area / (4) = 0.1731 (91)

MIT	14.0669	14.5136	15.3643	16.5392	17.5992	18.3553	18.6294	18.5900	18.0165	16.6379	15.1702	14.0297	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.0669	14.5136	15.3643	16.5392	17.5992	18.3553	18.6294	18.5900	18.0165	16.6379	15.1702	14.0297	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9658	0.9293	0.8558	0.7411	0.5768	0.3841	0.4564	0.7358	0.9137	0.9724	0.9864	(94)
Useful gains	1209.6201	1720.4140	2316.8179	2879.5460	2991.8305	2382.8781	1504.6940	1543.3603	1994.3656	1740.6120	1289.7064	1094.1330	(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	8478.4284	8312.6902	7635.1587	6460.2203	4971.4918	3113.5020	1682.5983	1810.2141	3267.7158	5088.4066	6848.9497	8403.1501	(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	5407.9933	4430.0096	3956.8456	2578.0854	1472.8680	0.0000	0.0000	0.0000	0.0000	2490.7592	4002.6552	5437.9088	(98)

Space heating 29777.1251 (98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 153.2297 (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)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	89.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	33457.4439 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	5407.9933	4430.0096	3956.8456	2578.0854	1472.8680	0.0000	0.0000	0.0000	0.0000	2490.7592	4002.6552	5437.9088	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	6076.3970	4977.5389	4445.8939	2896.7252	1654.9078	0.0000	0.0000	0.0000	0.0000	2798.6059	4497.3654	6110.0098	(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	251.8194	222.2741	234.1896	210.9795	207.5093	186.5038	180.1506	196.2562	195.4631	218.7225	229.9639	246.1131	(64)
Efficiency of water heater												78.3000	(216)
(217)m	88.4621	88.4227	88.3255	88.0894	87.5230	78.3000	78.3000	78.3000	78.3000	88.0289	88.3441	88.4765	(217)
Fuel for water heating, kWh/month	284.6635	251.3767	265.1436	239.5062	237.0911	238.1913	230.0774	250.6464	249.6335	248.4666	260.3048	278.1678	(219)
Water heating fuel used												3033.2690	(219)

Annual totals kWh/year	
Space heating fuel - main system	33457.4439 (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)	575.6498 (232)
Total delivered energy for all uses	37096.3627 (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	33457.4439	0.2160	7226.8079	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	3033.2690	0.2160	655.1861	(264)
Space and water heating			7881.9940	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	575.6498	0.5190	298.7622	(268)
Total CO2, kg/year			8196.3262	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			42.1800	(273)

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

DER		42.1800	ZC1
Total Floor Area	TFA	194.3300	
Assumed number of occupants	N	2.9945	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.1491	ZC2
CO2 emissions from cooking, equation (L16)		0.9822	ZC3
Total CO2 emissions		54.3113	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		54.3113	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	112.4000 (1b)	x	2.7800 (2b)	=	312.4720	(1b) - (3b)
First floor	81.9300 (1c)	x	3.1100 (2c)	=	254.8023	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	194.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	567.2743	(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							4 * 10 =	40.0000	(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) =	40.0000 / (5) =	0.0705	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3205	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2965	(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	0.3780	0.3706	0.3632	0.3261	0.3187	0.2817	0.2817	0.2742	0.2965	0.3187	0.3335	0.3484	(22b)
Effective ac	0.5714	0.5687	0.5660	0.5532	0.5508	0.5397	0.5397	0.5376	0.5439	0.5508	0.5556	0.5607	(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			2.0400	1.0000	2.0400			(26)
TER Opening Type (Uw = 1.40)			31.5400	1.3258	41.8144			(27)
TER Room Window (Uw = 1.70)			15.0000	1.5918	23.8764			(27a)
Heat Loss Floor 1			112.4000	0.1300	14.6120			(28a)
External Wall 1	103.9700	10.3600	93.6100	0.1800	16.8498			(29a)
External Wall 2	156.8000	23.2200	133.5800	0.1800	24.0444			(29a)
External Roof 1	28.2500		28.2500	0.1300	3.6725			(30)
External Roof 2	20.4300		20.4300	0.1300	2.6559			(30)
External Roof 3	39.3800		39.3800	0.1300	5.1194			(30)
External Roof 4	29.9800	15.0000	14.9800	0.1300	1.9474			(30)
External Roof 5	3.6500		3.6500	0.1300	0.4745			(30)
Total net area of external elements Aum(A, m2)			494.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	137.1067			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		24.7430 (36)
Total fabric heat loss	(33) + (36) =	161.8497 (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	106.9746	106.4552	105.9462	103.5551	103.1078	101.0253	101.0253	100.6396	101.8274	103.1078	104.0128	104.9589	(38)
Heat transfer coeff	268.8243	268.3049	267.7959	265.4048	264.9575	262.8750	262.8750	262.4893	263.6771	264.9575	265.8625	266.8086	(39)
Average = Sum(39)m / 12 =												265.4027	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3833	1.3807	1.3780	1.3657	1.3634	1.3527	1.3527	1.3507	1.3569	1.3634	1.3681	1.3730	(40)
HLP (average)												1.3657	(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	2.9945 (42)
Average daily hot water use (litres/day)	105.3203 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.8523	111.6395	107.4267	103.2139	99.0011	94.7883	94.7883	99.0011	103.2139	107.4267	111.6395	115.8523	(44)
Energy conte	171.8056	150.2623	155.0572	135.1827	129.7110	111.9307	103.7203	119.0205	120.4420	140.3635	153.2178	166.3846	(45)
Energy content (annual)										Total = Sum(45)m =		1657.0983	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              25.7708    22.5393    23.2586    20.2774    19.4566    16.7896    15.5580    17.8531    18.0663    21.0545    22.9827    24.9577 (46)
Water storage loss:
Store volume                                                                                                                            300.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             2.1127 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                1.1409 (55)
Total storage loss
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             230.4345   203.2174   213.6861   191.9202   188.3398   168.6683   162.3491   177.6493   177.1796   198.9924   209.9553   225.0134 (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
             230.4345   203.2174   213.6861   191.9202   188.3398   168.6683   162.3491   177.6493   177.1796   198.9924   209.9553   225.0134 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =             2347.4053 (64)
Heat gains from water heating, kWh/month
             104.0284    92.3263    98.4596    90.3383    90.0320    82.6070    81.3900    86.4774    85.4370    93.5739    96.3350   102.2259 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269   149.7269 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              32.5957    28.9512    23.5447    17.8248    13.3243    11.2489    12.1549    15.7993    21.2058    26.9257    31.4262    33.5016 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             365.6243   369.4184   359.8575   339.5036   313.8104   289.6625   273.5302   269.7361   279.2970   299.6509   325.3441   349.4920 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727    37.9727 (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)
            -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815  -119.7815 (71)
Water heating gains (Table 5)
             139.8232   137.3903   132.3382   125.4698   121.0107   114.7320   109.3952   116.2330   118.6625   125.7714   133.7986   137.4004 (72)
Total internal gains
             608.9612   606.6779   586.6584   553.7164   519.0635   486.5614   465.9983   472.6866   490.0834   523.2661   561.4869   591.3121 (73)
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6. Solar gains

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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data      factor               W
                                                          W/m2         or Table 6b      or Table 6c        Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                4.9400          11.2829           0.6300           0.7000          0.7700          17.0342 (75)
Southeast                               13.1100          36.7938           0.6300           0.7000          0.7700         147.4177 (77)
Southwest                                0.3800          36.7938           0.6300           0.7000          0.7700           4.2730 (79)
Northwest                               13.1100          11.2829           0.6300           0.7000          0.7700          45.2061 (81)
Southeast                               15.0000          26.0000           0.6300           0.7000          1.0000         154.7910 (82)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains   368.7219   706.5661  1153.3284  1705.9367  2137.6131  2215.0032  2097.3705  1765.7052  1345.5915   833.3293   456.4703   305.6676 (83)
Total gains   977.6831  1313.2440  1739.9868  2259.6530  2656.6765  2701.5647  2563.3688  2238.3917  1835.6749  1356.5953  1017.9572   896.9797 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          50.2006    50.2978    50.3934    50.8474    50.9332    51.3367    51.3367    51.4121    51.1805    50.9332    50.7598    50.5798
alpha         4.3467     4.3532     4.3596     4.3898     4.3955     4.4224     4.4224     4.4275     4.4120     4.3955     4.3840     4.3720
util living area
              0.9990     0.9961     0.9831     0.9254     0.7828     0.5914     0.4438     0.5227     0.8116     0.9770     0.9975     0.9993 (86)

MIT          19.3716    19.6032    19.9920    20.4791    20.8211    20.9606    20.9911    20.9825    20.8465    20.3347    19.7542    19.3346 (87)
Th 2          19.7761    19.7782    19.7802    19.7897    19.7915    19.7998    19.7998    19.8013    19.7966    19.7915    19.7879    19.7841 (88)
util rest of house
              0.9986     0.9947     0.9769     0.8992     0.7185     0.4934     0.3265     0.3947     0.7256     0.9647     0.9963     0.9990 (89)
MIT 2         17.6142    17.9538    18.5184    19.2051    19.6313    19.7765    19.7970    19.7950    19.6805    19.0238    18.1819    17.5654 (90)
Living area fraction                                                                                  fLA = Living area / (4) =          0.1731 (91)
MIT          17.9183    18.2393    18.7734    19.4256    19.8372    19.9814    20.0036    20.0005    19.8823    19.2507    18.4540    17.8715 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT  17.9183    18.2393    18.7734    19.4256    19.8372    19.9814    20.0036    20.0005    19.8823    19.2507    18.4540    17.8715 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9976     0.9919     0.9696     0.8894     0.7212     0.5089     0.3469     0.4168     0.7327     0.9567     0.9943     0.9984 (94)
Useful gains 975.3750  1302.6177  1687.0689  2009.7881  1915.9239  1374.9046   889.1663   932.9780  1344.9942  1297.9171  1012.1927   895.5112 (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
             3660.9415  3578.9950  3286.7707  2793.5386  2156.0033  1414.6443   894.7265   945.0943  1524.6602  2292.0555  3018.6006  3647.6837 (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
             1998.0615  1529.7256  1190.1782   564.3004   178.6191     0.0000     0.0000     0.0000     0.0000   739.6389  1444.6137  2047.6163 (98)
Space heating                                                                                                                          9692.7537 (98)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 49.8778 (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)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 10366.5815 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1998.0615	1529.7256	1190.1782	564.3004	178.6191	0.0000	0.0000	0.0000	0.0000	739.6389	1444.6137	2047.6163	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	2136.9641	1636.0701	1272.9178	603.5298	191.0365	0.0000	0.0000	0.0000	0.0000	791.0577	1545.0414	2189.9640	(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	230.4345	203.2174	213.6861	191.9202	188.3398	168.6683	162.3491	177.6493	177.1796	198.9924	209.9553	225.0134	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.2624	89.0990	88.6899	87.5217	84.6729	79.8000	79.8000	79.8000	79.8000	87.9985	88.9859	89.3143	(217)
Fuel for water heating, kWh/month	258.1540	228.0804	240.9362	219.2830	222.4321	211.3638	203.4450	222.6182	222.0295	226.1315	235.9422	251.9344	(219)
Water heating fuel used												2742.3503	(219)

Annual totals kWh/year
Space heating fuel - main system 10366.5815 (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) 575.6498 (232)
Total delivered energy for all uses 13759.5816 (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	10366.5815	0.2160	2239.1816	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2742.3503	0.2160	592.3477	(264)
Space and water heating			2831.5293	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	575.6498	0.5190	298.7622	(268)
Total CO2, kg/m2/year			3169.2165	(272)
Emissions per m2 for space and water heating			14.5707	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.5374	(272b)
Emissions per m2 for pumps and fans			0.2003	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5707 * 1.00) + 1.5374 + 0.2003, rounded to 2 d.p.			16.3100	(273)

APPENDIX B – SAP CALCULATIONS FOR THE PROPOSED NEW DWELLING

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

Design SAP
elmhurst energy

Property Reference	121919	**Issued on Date**	03/02/2020
Assessment Reference	ASHP	**Prop Type Ref**	
Property	38, Frognal Lane, London, NW3 6PP		

SAP Rating	81 B	**DER**	15.25	**TER**	19.28
Environmental	83 B	**% DER<TER**	20.89		
CO_2 Emissions (t/year)	5.28	**DFEE**	44.08	**TFEE**	55.21
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.16		

Assessor Details	Mrs. Nicola Battista, Monitor Energy Consultancy, Tel: 01752830291, nicola@monitor-ec.co.uk	**Assessor ID**	L706-0001
Client			

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DWELLING AS DESIGNED

Detached House, total floor area 426 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 19.28 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.25 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.1 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (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: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.89 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW 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): Slight OK
Based on:
Overshading: Average
Windows facing East: 6.72 m², No overhang
Windows facing South East: 35.89 m², No overhang
Windows facing West: 0.45 m², No overhang
Windows facing North West: 22.82 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Floor U-value 0.11 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	164.8800 (1b)	x	2.6000 (2b)	=	428.6880 (1b) - (3b)	
First floor	159.9800 (1c)	x	3.0000 (2c)	=	479.9400 (1c) - (3c)	
Second floor	101.6200 (1d)	x	2.6900 (2d)	=	273.3578 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	426.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1181.9858	(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							7 * 10	=	70.0000	(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) =	70.0000 / (5) =	0.0592	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2592	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2398	(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	0.3057	0.2997	0.2937	0.2638	0.2578	0.2278	0.2278	0.2218	0.2398	0.2578	0.2698	0.2817	(22b)
Effective ac	0.5467	0.5449	0.5431	0.5348	0.5332	0.5259	0.5259	0.5246	0.5287	0.5332	0.5364	0.5397	(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	
Opening Type 1			4.4100	1.2000	5.2920			(26)
Opening Type 2			1.4000	1.2000	1.6800			(26a)
Opening Type 3 (Uw = 1.20)			65.8800	1.1450	75.4351			(27)
Opening Type 4 (Uw = 1.20)			7.2000	1.1450	8.2443			(27a)
Heat Loss Floor 1			164.8800	0.1100	18.1368			(28a)
External Wall 1	335.3600	67.1800	268.1800	0.1800	48.2724			(29a)
External Wall 2	12.7400	4.5100	8.2300	0.1800	1.4814			(29a)
External Roof 1	182.8400	5.7600	177.0800	0.1300	23.0204			(30)
External Roof 2	30.0400	1.4400	28.6000	0.1300	3.7180			(30)
External Roof 3	6.4000		6.4000	0.1300	0.8320			(30)
External Roof 4	4.9000		4.9000	0.1300	0.6370			(30)
Total net area of external elements Aum(A, m2)			737.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		186.7494			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	36.1424	(36)
Total fabric heat loss (33) + (36) =	222.8918	(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	213.2559	212.5481	211.8543	208.5955	207.9858	205.1475	205.1475	204.6218	206.2407	207.9858	209.2192	210.5087	(38)
Heat transfer coeff	436.1477	435.4399	434.7461	431.4873	430.8776	428.0392	428.0392	427.5136	429.1325	430.8776	432.1110	433.4005	(39)
Average = Sum(39)m / 12 =												431.4843	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0227	1.0210	1.0194	1.0117	1.0103	1.0037	1.0037	1.0024	1.0062	1.0103	1.0132	1.0162	(40)
HLP (average)												1.0117	(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	3.2964	(42)
Average daily hot water use (litres/day)	118.4089	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.2497	125.5134	120.7770	116.0407	111.3043	106.5680	106.5680	111.3043	116.0407	120.7770	125.5134	130.2497	(44)
Energy conte	193.1566	168.9360	174.3268	151.9823	145.8307	125.8408	116.6100	133.8117	135.4098	157.8071	172.2587	187.0618	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1863.0323	(45)
Distribution loss (46)m = 0.15 x (45)m													
	28.9735	25.3404	26.1490	22.7974	21.8746	18.8761	17.4915	20.0717	20.3115	23.6711	25.8388	28.0593	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0206	(55)
Total storage loss													
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)
If cylinder contains dedicated solar storage													
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(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													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(64)
											Total per year (kWh/year) = Sum(64)m =	2509.4473	(64)
Heat gains from water heating, kWh/month													
	108.1454	95.8416	101.8845	93.0381	92.4095	84.3461	82.6936	88.4132	87.5278	96.3916	99.7800	106.1189	(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	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.7007	45.0319	36.6224	27.7255	20.7252	17.4971	18.9062	24.5750	32.9845	41.8814	48.8818	52.1099	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	554.1290	559.8791	545.3890	514.5412	475.6014	439.0035	414.5539	408.8038	423.2939	454.1417	493.0814	529.6793	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	(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)													
	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	(71)
Water heating gains (Table 5)													
	145.3567	142.6215	136.9415	129.2196	124.2063	117.1473	111.1473	118.8349	121.5663	129.5587	138.5834	142.6329	(72)
Total internal gains													
	825.6317	822.9778	794.3982	746.9317	695.9782	649.0932	620.0527	627.6590	653.2900	701.0270	755.9919	799.8674	(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	
East	6.7200	19.6403	0.7200	0.7000	0.7700	46.0978	(76)
Southeast	35.8900	36.7938	0.7200	0.7000	0.7700	461.2244	(77)
West	0.4500	19.6403	0.7200	0.7000	0.7700	3.0869	(80)
Northwest	22.8200	11.2829	0.7200	0.7000	0.7700	89.9294	(81)
Southeast	2.8800	39.9751	0.7200	0.7000	1.0000	52.2222	(82)
Northwest	2.8800	16.3666	0.7200	0.7000	1.0000	21.3808	(82)
Horizontal	1.4400	26.0000	0.7200	0.7000	1.0000	16.9828	(82)

Solar gains	690.9243	1240.1778	1853.5273	2540.5498	3054.7858	3121.0923	2972.5448	2577.7717	2090.9482	1414.0036	839.3684	583.5018	(83)
Total gains	1516.5560	2063.1556	2647.9255	3287.4814	3750.7640	3770.1856	3592.5976	3205.4307	2744.2382	2115.0306	1595.3602	1383.3692	(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	67.9051	68.0155	68.1241	68.6386	68.7357	69.1915	69.1915	69.2765	69.0152	68.7357	68.5395	68.3356	
alpha	5.5270	5.5344	5.5416	5.5759	5.5824	5.6128	5.6128	5.6184	5.6010	5.5824	5.5693	5.5557	
util living area													
	0.9999	0.9992	0.9952	0.9705	0.8747	0.6890	0.5175	0.5976	0.8788	0.9920	0.9995	0.9999	(86)
MIT	19.9757	20.1138	20.3303	20.6073	20.8282	20.9275	20.9475	20.9430	20.8583	20.5475	20.2040	19.9527	(87)
Th 2	20.0645	20.0659	20.0672	20.0736	20.0747	20.0803	20.0803	20.0813	20.0782	20.0747	20.0723	20.0698	(88)
util rest of house													
	0.9998	0.9989	0.9935	0.9591	0.8312	0.6051	0.4129	0.4863	0.8185	0.9876	0.9993	0.9999	(89)
MIT 2	18.6653	18.8686	19.1857	19.5882	19.8816	19.9933	20.0078	20.0068	19.9278	19.5086	19.0058	18.6358	(90)
Living area fraction										fLA = Living area / (4) =		0.1953	(91)
MIT	18.9212	19.1118	19.4092	19.7872	20.0665	20.1758	20.1913	20.1896	20.1095	19.7115	19.2398	18.8930	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9212	19.1118	19.4092	19.7872	20.0665	20.1758	20.1913	20.1896	20.1095	19.7115	19.2398	18.8930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9997	0.9985	0.9917	0.9546	0.8308	0.6143	0.4258	0.5000	0.8209	0.9851	0.9991	0.9998	(94)
Useful gains	1516.1435	2060.0036	2625.9945	3138.3629	3116.0099	2315.9292	1529.7029	1602.5904	2252.8464	2083.6134	1593.8929	1383.1449	(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													
	6376.9993	6188.3732	5612.2321	4697.6957	3604.9293	2386.6441	1537.2287	1620.1120	2578.8789	3925.9272	5245.7333	6367.9509	(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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

	3616.4767	2774.2644	2221.7608	1122.7197	363.7561	0.0000	0.0000	0.0000	0.0000	1370.6815	2629.3251	3708.6957 (98)
Space heating												17807.6799 (98)
Space heating per m2											(98) / (4) =	41.7550 (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)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	175.1000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	10170.0057 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3616.4767	2774.2644	2221.7608	1122.7197	363.7561	0.0000	0.0000	0.0000	0.0000	1370.6815	2629.3251	3708.6957	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	2065.3779	1584.3886	1268.8525	641.1877	207.7419	0.0000	0.0000	0.0000	0.0000	782.7993	1501.6134	2118.0444	(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													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	141.6662	124.7995	130.9125	117.1401	114.6383	102.2106	97.9503	107.7742	107.6755	121.4780	128.7200	138.1855	(219)
Water heating fuel used												1433.1509	(219)
Annual totals kWh/year													
Space heating fuel - main system												10170.0057	(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)												895.3907	(232)
Total delivered energy for all uses												12528.5473	(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	10170.0057	0.5190	5278.2329	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1433.1509	0.5190	743.8053	(264)
Space and water heating			6022.0383	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	895.3907	0.5190	464.7078	(268)
Total CO2, kg/year			6502.3161	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.2500	(273)

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

DER		15.2500	ZC1
Total Floor Area	TFA	426.4800	
Assumed number of occupants	N	3.2964	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		7.6994	ZC2
CO2 emissions from cooking, equation (L16)		0.4645	ZC3
Total CO2 emissions		23.4140	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		23.4140	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	164.8800 (1b)	x	2.6000 (2b)	=	428.6880	(1b) - (3b)
First floor	159.9800 (1c)	x	3.0000 (2c)	=	479.9400	(1c) - (3c)
Second floor	101.6200 (1d)	x	2.6900 (2d)	=	273.3578	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	426.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1181.9858	(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							4 * 10	=	40.0000	(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) =	40.0000	/ (5) =	0.0338	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2838	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2626	(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	0.3348	0.3282	0.3216	0.2888	0.2822	0.2494	0.2494	0.2429	0.2626	0.2822	0.2954	0.3085	(22b)
Effective ac	0.5560	0.5539	0.5517	0.5417	0.5398	0.5311	0.5311	0.5295	0.5345	0.5398	0.5436	0.5476	(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			4.4100	1.0000	4.4100			(26)
TER Semi-glazed door			1.4000	1.2000	1.6800			(26a)
TER Opening Type (Uw = 1.40)			65.8800	1.3258	87.3409			(27)
TER Room Window (Uw = 1.70)			7.2000	1.5918	11.4607			(27a)
Heat Loss Floor 1			164.8800	0.1300	21.4344			(28a)
External Wall 1	335.3600	67.1800	268.1800	0.1800	48.2724			(29a)
External Wall 2	12.7400	4.5100	8.2300	0.1800	1.4814			(29a)
External Roof 1	182.8400	5.7600	177.0800	0.1300	23.0204			(30)
External Roof 2	30.0400	1.4400	28.6000	0.1300	3.7180			(30)
External Roof 3	6.4000		6.4000	0.1300	0.8320			(30)
External Roof 4	4.9000		4.9000	0.1300	0.6370			(30)
Total net area of external elements Aum(A, m2)			737.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		204.2872			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			29.8083	(36)
Total fabric heat loss	(33) + (36) =		234.0955	(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	216.8827	216.0340	215.2022	211.2950	210.5640	207.1609	207.1609	206.5307	208.4717	210.5640	212.0428	213.5889	(38)
Heat transfer coeff	450.9782	450.1295	449.2977	445.3905	444.6595	441.2564	441.2564	440.6262	442.5672	444.6595	446.1383	447.6844	(39)
Average = Sum(39)m / 12 =												445.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0574	1.0555	1.0535	1.0443	1.0426	1.0346	1.0346	1.0332	1.0377	1.0426	1.0461	1.0497	(40)
HLP (average)												1.0443	(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	3.2964	(42)
Average daily hot water use (litres/day)	112.4884	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.7372	119.2377	114.7382	110.2386	105.7391	101.2396	101.2396	105.7391	110.2386	114.7382	119.2377	123.7372	(44)
Energy conte	183.4988	160.4892	165.6105	144.3832	138.5391	119.5487	110.7795	127.1211	128.6393	149.9167	163.6458	177.7088	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1769.8807	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5248	24.0734	24.8416	21.6575	20.7809	17.9323	16.6169	19.0682	19.2959	22.4875	24.5469	26.6563	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(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													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(64)
										Total per year (kWh/year) = Sum(64)m =		2460.1877	(64)
Heat gains from water heating, kWh/month													
	107.9164	95.7267	101.9685	93.3975	92.9673	85.1400	83.7372	89.1708	88.1626	96.7504	99.8023	105.9912	(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	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.7007	45.0319	36.6224	27.7255	20.7252	17.4971	18.9062	24.5750	32.9845	41.8814	48.8818	52.1099	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	554.1290	559.8791	545.3890	514.5412	475.6014	439.0035	414.5539	408.8038	423.2939	454.1417	493.0814	529.6793	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	(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)													
	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	(71)
Water heating gains (Table 5)													
	145.0489	142.4504	137.0545	129.7187	124.9561	118.2500	112.5500	119.8532	122.4481	130.0408	138.6143	142.4613	(72)
Total internal gains													
	825.3239	822.8068	794.5112	747.4308	696.7280	650.1959	621.4554	628.6773	654.1718	701.5092	756.0228	799.6958	(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	
East	6.7200	19.6403	0.6300	0.7000	0.7700	40.3356	(76)
Southeast	35.8900	36.7938	0.6300	0.7000	0.7700	403.5713	(77)
West	0.4500	19.6403	0.6300	0.7000	0.7700	2.7010	(80)
Northwest	22.8200	11.2829	0.6300	0.7000	0.7700	78.6882	(81)
Southeast	2.8800	39.9751	0.6300	0.7000	1.0000	45.6945	(82)
Northwest	2.8800	16.3666	0.6300	0.7000	1.0000	18.7082	(82)
Horizontal	1.4400	26.0000	0.6300	0.7000	1.0000	14.8599	(82)

Solar gains	604.5588	1085.1556	1621.8364	2222.9811	2672.9375	2730.9558	2600.9767	2255.5503	1829.5796	1237.2531	734.4473	510.5641	(83)
Total gains	1429.8827	1907.9624	2416.3476	2970.4118	3369.6655	3381.1517	3222.4322	2884.2276	2483.7514	1938.7623	1490.4701	1310.2599	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.6721	65.7959	65.9177	66.4960	66.6053	67.1189	67.1189	67.2149	66.9202	66.6053	66.3845	66.1552	
alpha	5.3781	5.3864	5.3945	5.4331	5.4404	5.4746	5.4746	5.4810	5.4613	5.4404	5.4256	5.4103	
util living area													
	0.9999	0.9994	0.9970	0.9820	0.9170	0.7606	0.5870	0.6691	0.9180	0.9949	0.9997	0.9999	(86)
MIT	19.6333	19.8034	20.0797	20.4449	20.7652	20.9433	20.9887	20.9782	20.8261	20.3945	19.9425	19.6068	(87)
Th 2	20.0357	20.0374	20.0390	20.0465	20.0480	20.0546	20.0546	20.0558	20.0520	20.0480	20.0451	20.0421	(88)
util rest of house													
	0.9999	0.9992	0.9958	0.9744	0.8825	0.6760	0.4689	0.5481	0.8690	0.9919	0.9995	0.9999	(89)
MIT 2	18.1767	18.4269	18.8319	19.3657	19.8051	20.0146	20.0501	20.0459	19.8953	19.2986	18.6362	18.1425	(90)
Living area fraction										fLA = Living area / (4) =		0.1953	(91)
MIT	18.4611	18.6957	19.0756	19.5765	19.9926	20.1960	20.2334	20.2280	20.0771	19.5126	18.8913	18.4285	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4611	18.6957	19.0756	19.5765	19.9926	20.1960	20.2334	20.2280	20.0771	19.5126	18.8913	18.4285	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9988	0.9941	0.9694	0.8801	0.6898	0.4920	0.5716	0.8706	0.9894	0.9992	0.9998	(94)
Useful gains	1429.5281	1905.6674	2402.1352	2879.5154	2965.7425	2332.1662	1585.4498	1648.5285	2162.2767	1918.3042	1489.3296	1310.0596	(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													
	6386.3683	6209.8619	5650.1864	4755.2073	3687.3954	2469.2518	1603.2780	1686.7160	2645.2688	3963.0762	5260.5589	6369.8631	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating kWh
3687.8891 2892.4187 2416.5500 1350.4982 536.9098 0.0000 0.0000 0.0000 0.0000 1521.3104 2715.2851 3764.4938 (98)
Space heating 18885.3552 (98)
Space heating per m2 (98) / (4) = 44.2819 (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)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 20198.2409 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3687.8891	2892.4187	2416.5500	1350.4982	536.9098	0.0000	0.0000	0.0000	0.0000	1521.3104	2715.2851	3764.4938	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	3944.2664	3093.4960	2584.5455	1444.3831	574.2351	0.0000	0.0000	0.0000	0.0000	1627.0699	2904.0482	4026.1966	(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													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.7585	89.6737	89.4812	88.9540	87.3540	79.8000	79.8000	79.8000	79.8000	89.0604	89.5981	89.7888	(217)
Fuel for water heating, kWh/month													
	269.7545	238.0233	250.5993	226.0953	225.7114	220.9102	212.2911	232.7693	232.3018	234.1620	245.9688	263.2149	(219)
Water heating fuel used												2851.8019	(219)
Annual totals kWh/year													
Space heating fuel - main system												20198.2409	(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)												895.3907	(232)
Total delivered energy for all uses												24020.4335	(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	20198.2409	0.2160	4362.8200	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2851.8019	0.2160	615.9892	(264)
Space and water heating			4978.8092	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	895.3907	0.5190	464.7078	(268)
Total CO2, kg/m2/year			5482.4420	(272)
Emissions per m2 for space and water heating			11.6742	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.0896	(272b)
Emissions per m2 for pumps and fans			0.0913	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.6742 * 1.55) + 1.0896 + 0.0913, rounded to 2 d.p.			19.2800	(273)

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

Design SAP
elmhurst energy

Property Reference	121919	**Issued on Date**	07/02/2020
Assessment Reference	ASHP + PV	**Prop Type Ref**	
Property	38, Frognal Lane, London, NW3 6PP		

SAP Rating	85 B	**DER**	12.47	**TER**	19.28
Environmental	86 B	**% DER<TER**	35.31		
CO_2 Emissions (t/year)	4.04	**DFEE**	44.08	**TFEE**	55.21
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.16		

Assessor Details	Mrs. Nicola Battista, Monitor Energy Consultancy, Tel: 01752830291, nicola@monitor-ec.co.uk	**Assessor ID**	L706-0001
Client			

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

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

Detached House, total floor area 426 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 19.28 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.47 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.20 (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: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.89 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 6.72 m², No overhang
Windows facing South East: 35.89 m², No overhang
Windows facing West: 0.45 m², No overhang
Windows facing North West: 22.82 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Floor U-value 0.11 W/m²K
Photovoltaic array 2.80 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	164.8800 (1b)	x	2.6000 (2b)	=	428.6880 (1b) - (3b)	
First floor	159.9800 (1c)	x	3.0000 (2c)	=	479.9400 (1c) - (3c)	
Second floor	101.6200 (1d)	x	2.6900 (2d)	=	273.3578 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	426.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1181.9858	(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							7 * 10	=	70.0000	(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) =	70.0000 / (5) =	0.0592	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2592	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2398	(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	0.3057	0.2997	0.2937	0.2638	0.2578	0.2278	0.2278	0.2218	0.2398	0.2578	0.2698	0.2817	(22b)
Effective ac	0.5467	0.5449	0.5431	0.5348	0.5332	0.5259	0.5259	0.5246	0.5287	0.5332	0.5364	0.5397	(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	
Opening Type 1			4.4100	1.2000	5.2920			(26)
Opening Type 2			1.4000	1.2000	1.6800			(26a)
Opening Type 3 (Uw = 1.20)			65.8800	1.1450	75.4351			(27)
Opening Type 4 (Uw = 1.20)			7.2000	1.1450	8.2443			(27a)
Heat Loss Floor 1			164.8800	0.1100	18.1368			(28a)
External Wall 1	335.3600	67.1800	268.1800	0.1800	48.2724			(29a)
External Wall 2	12.7400	4.5100	8.2300	0.1800	1.4814			(29a)
External Roof 1	182.8400	5.7600	177.0800	0.1300	23.0204			(30)
External Roof 2	30.0400	1.4400	28.6000	0.1300	3.7180			(30)
External Roof 3	6.4000		6.4000	0.1300	0.8320			(30)
External Roof 4	4.9000		4.9000	0.1300	0.6370			(30)
Total net area of external elements Aum(A, m2)			737.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		186.7494			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	36.1424	(36)
Total fabric heat loss (33) + (36) =	222.8918	(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	213.2559	212.5481	211.8543	208.5955	207.9858	205.1475	205.1475	204.6218	206.2407	207.9858	209.2192	210.5087	(38)
Heat transfer coeff	436.1477	435.4399	434.7461	431.4873	430.8776	428.0392	428.0392	427.5136	429.1325	430.8776	432.1110	433.4005	(39)
Average = Sum(39)m / 12 =												431.4843	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0227	1.0210	1.0194	1.0117	1.0103	1.0037	1.0037	1.0024	1.0062	1.0103	1.0132	1.0162	(40)
HLP (average)												1.0117	(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	3.2964	(42)
Average daily hot water use (litres/day)	118.4089	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	130.2497	125.5134	120.7770	116.0407	111.3043	106.5680	106.5680	111.3043	116.0407	120.7770	125.5134	130.2497	(44)
Energy conte	193.1566	168.9360	174.3268	151.9823	145.8307	125.8408	116.6100	133.8117	135.4098	157.8071	172.2587	187.0618	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1863.0323	(45)
Distribution loss (46)m = 0.15 x (45)m													
	28.9735	25.3404	26.1490	22.7974	21.8746	18.8761	17.4915	20.0717	20.3115	23.6711	25.8388	28.0593	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0206	(55)
Total storage loss													
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)
If cylinder contains dedicated solar storage													
	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(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													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(64)
											Total per year (kWh/year) = Sum(64)m =	2509.4473	(64)
Heat gains from water heating, kWh/month													
	108.1454	95.8416	101.8845	93.0381	92.4095	84.3461	82.6936	88.4132	87.5278	96.3916	99.7800	106.1189	(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	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.7007	45.0319	36.6224	27.7255	20.7252	17.4971	18.9062	24.5750	32.9845	41.8814	48.8818	52.1099	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	554.1290	559.8791	545.3890	514.5412	475.6014	439.0035	414.5539	408.8038	423.2939	454.1417	493.0814	529.6793	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	(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)													
	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	(71)
Water heating gains (Table 5)													
	145.3567	142.6215	136.9415	129.2196	124.2063	117.1473	111.1473	118.8349	121.5663	129.5587	138.5834	142.6329	(72)
Total internal gains													
	825.6317	822.9778	794.3982	746.9317	695.9782	649.0932	620.0527	627.6590	653.2900	701.0270	755.9919	799.8674	(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	
East	6.7200	19.6403	0.7200	0.7000	0.7700	46.0978	(76)
Southeast	35.8900	36.7938	0.7200	0.7000	0.7700	461.2244	(77)
West	0.4500	19.6403	0.7200	0.7000	0.7700	3.0869	(80)
Northwest	22.8200	11.2829	0.7200	0.7000	0.7700	89.9294	(81)
Southeast	2.8800	39.9751	0.7200	0.7000	1.0000	52.2222	(82)
Northwest	2.8800	16.3666	0.7200	0.7000	1.0000	21.3808	(82)
Horizontal	1.4400	26.0000	0.7200	0.7000	1.0000	16.9828	(82)

Solar gains	690.9243	1240.1778	1853.5273	2540.5498	3054.7858	3121.0923	2972.5448	2577.7717	2090.9482	1414.0036	839.3684	583.5018	(83)
Total gains	1516.5560	2063.1556	2647.9255	3287.4814	3750.7640	3770.1856	3592.5976	3205.4307	2744.2382	2115.0306	1595.3602	1383.3692	(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	67.9051	68.0155	68.1241	68.6386	68.7357	69.1915	69.1915	69.2765	69.0152	68.7357	68.5395	68.3356	
alpha	5.5270	5.5344	5.5416	5.5759	5.5824	5.6128	5.6128	5.6184	5.6010	5.5824	5.5693	5.5557	
util living area													
	0.9999	0.9992	0.9952	0.9705	0.8747	0.6890	0.5175	0.5976	0.8788	0.9920	0.9995	0.9999	(86)
MIT	19.9757	20.1138	20.3303	20.6073	20.8282	20.9275	20.9475	20.9430	20.8583	20.5475	20.2040	19.9527	(87)
Th 2	20.0645	20.0659	20.0672	20.0736	20.0747	20.0803	20.0803	20.0813	20.0782	20.0747	20.0723	20.0698	(88)
util rest of house													
	0.9998	0.9989	0.9935	0.9591	0.8312	0.6051	0.4129	0.4863	0.8185	0.9876	0.9993	0.9999	(89)
MIT 2	18.6653	18.8686	19.1857	19.5882	19.8816	19.9933	20.0078	20.0068	19.9278	19.5086	19.0058	18.6358	(90)
Living area fraction										fLA = Living area / (4) =		0.1953	(91)
MIT	18.9212	19.1118	19.4092	19.7872	20.0665	20.1758	20.1913	20.1896	20.1095	19.7115	19.2398	18.8930	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9212	19.1118	19.4092	19.7872	20.0665	20.1758	20.1913	20.1896	20.1095	19.7115	19.2398	18.8930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9997	0.9985	0.9917	0.9546	0.8308	0.6143	0.4258	0.5000	0.8209	0.9851	0.9991	0.9998	(94)
Useful gains	1516.1435	2060.0036	2625.9945	3138.3629	3116.0099	2315.9292	1529.7029	1602.5904	2252.8464	2083.6134	1593.8929	1383.1449	(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													
	6376.9993	6188.3732	5612.2321	4697.6957	3604.9293	2386.6441	1537.2287	1620.1120	2578.8789	3925.9272	5245.7333	6367.9509	(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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

	3616.4767	2774.2644	2221.7608	1122.7197	363.7561	0.0000	0.0000	0.0000	0.0000	1370.6815	2629.3251	3708.6957 (98)

Space heating 17807.6799 (98)
Space heating per m2 (98) / (4) = 41.7550 (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)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 175.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 10170.0057 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3616.4767	2774.2644	2221.7608	1122.7197	363.7561	0.0000	0.0000	0.0000	0.0000	1370.6815	2629.3251	3708.6957	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	2065.3779	1584.3886	1268.8525	641.1877	207.7419	0.0000	0.0000	0.0000	0.0000	782.7993	1501.6134	2118.0444	(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													
	248.0576	218.5240	229.2278	205.1123	200.7317	178.9708	171.5110	188.7127	188.5398	212.7081	225.3887	241.9628	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	141.6662	124.7995	130.9125	117.1401	114.6383	102.2106	97.9503	107.7742	107.6755	121.4780	128.7200	138.1855	(219)
Water heating fuel used												1433.1509	(219)
Annual totals kWh/year													
Space heating fuel - main system												10170.0057	(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)												895.3907	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.80 * 1029 * 1.00) =											-1482.0289	-2285.2258	
PV Unit 1 (0.80 * 1.00 * 1004 * 1.00) =											-803.1970	-2285.2258	(233)
Total delivered energy for all uses												10243.3215	(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	10170.0057	0.5190	5278.2329	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1433.1509	0.5190	743.8053	(264)
Space and water heating			6022.0383	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	895.3907	0.5190	464.7078	(268)
Energy saving/generation technologies				
PV Unit	-2285.2258	0.5190	-1186.0322	(269)
Total CO2, kg/year			5316.2838	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.4700	(273)

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

DER		12.4700	ZC1
Total Floor Area	TFA	426.4800	
Assumed number of occupants	N	3.2964	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		7.6994	ZC2
CO2 emissions from cooking, equation (L16)		0.4645	ZC3
Total CO2 emissions		20.6340	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		20.6340	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	164.8800 (1b)	x	2.6000 (2b)	=	428.6880	(1b) - (3b)
First floor	159.9800 (1c)	x	3.0000 (2c)	=	479.9400	(1c) - (3c)
Second floor	101.6200 (1d)	x	2.6900 (2d)	=	273.3578	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	426.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1181.9858	(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							4 * 10	=	40.0000	(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) =	40.0000	/ (5) =	0.0338	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2838	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2626	(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	0.3348	0.3282	0.3216	0.2888	0.2822	0.2494	0.2494	0.2429	0.2626	0.2822	0.2954	0.3085	(22b)
Effective ac	0.5560	0.5539	0.5517	0.5417	0.5398	0.5311	0.5311	0.5295	0.5345	0.5398	0.5436	0.5476	(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			4.4100	1.0000	4.4100			(26)
TER Semi-glazed door			1.4000	1.2000	1.6800			(26a)
TER Opening Type (Uw = 1.40)			65.8800	1.3258	87.3409			(27)
TER Room Window (Uw = 1.70)			7.2000	1.5918	11.4607			(27a)
Heat Loss Floor 1			164.8800	0.1300	21.4344			(28a)
External Wall 1	335.3600	67.1800	268.1800	0.1800	48.2724			(29a)
External Wall 2	12.7400	4.5100	8.2300	0.1800	1.4814			(29a)
External Roof 1	182.8400	5.7600	177.0800	0.1300	23.0204			(30)
External Roof 2	30.0400	1.4400	28.6000	0.1300	3.7180			(30)
External Roof 3	6.4000		6.4000	0.1300	0.8320			(30)
External Roof 4	4.9000		4.9000	0.1300	0.6370			(30)
Total net area of external elements Aum(A, m2)			737.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		204.2872			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			29.8083	(36)
Total fabric heat loss	(33) + (36) =		234.0955	(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	216.8827	216.0340	215.2022	211.2950	210.5640	207.1609	207.1609	206.5307	208.4717	210.5640	212.0428	213.5889	(38)
Heat transfer coeff	450.9782	450.1295	449.2977	445.3905	444.6595	441.2564	441.2564	440.6262	442.5672	444.6595	446.1383	447.6844	(39)
Average = Sum(39)m / 12 =												445.3870	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0574	1.0555	1.0535	1.0443	1.0426	1.0346	1.0346	1.0332	1.0377	1.0426	1.0461	1.0497	(40)
HLP (average)												1.0443	(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	3.2964	(42)
Average daily hot water use (litres/day)	112.4884	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.7372	119.2377	114.7382	110.2386	105.7391	101.2396	101.2396	105.7391	110.2386	114.7382	119.2377	123.7372	(44)
Energy conte	183.4988	160.4892	165.6105	144.3832	138.5391	119.5487	110.7795	127.1211	128.6393	149.9167	163.6458	177.7088	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1769.8807	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.5248	24.0734	24.8416	21.6575	20.7809	17.9323	16.6169	19.0682	19.2959	22.4875	24.5469	26.6563	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(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													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(64)
										Total per year (kWh/year) = Sum(64)m =		2460.1877	(64)
Heat gains from water heating, kWh/month													
	107.9164	95.7267	101.9685	93.3975	92.9673	85.1400	83.7372	89.1708	88.1626	96.7504	99.8023	105.9912	(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	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	164.8177	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.7007	45.0319	36.6224	27.7255	20.7252	17.4971	18.9062	24.5750	32.9845	41.8814	48.8818	52.1099	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	554.1290	559.8791	545.3890	514.5412	475.6014	439.0035	414.5539	408.8038	423.2939	454.1417	493.0814	529.6793	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	39.4818	(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)													
	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	-131.8542	(71)
Water heating gains (Table 5)													
	145.0489	142.4504	137.0545	129.7187	124.9561	118.2500	112.5500	119.8532	122.4481	130.0408	138.6143	142.4613	(72)
Total internal gains													
	825.3239	822.8068	794.5112	747.4308	696.7280	650.1959	621.4554	628.6773	654.1718	701.5092	756.0228	799.6958	(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	
East	6.7200	19.6403	0.6300	0.7000	0.7700	40.3356	(76)
Southeast	35.8900	36.7938	0.6300	0.7000	0.7700	403.5713	(77)
West	0.4500	19.6403	0.6300	0.7000	0.7700	2.7010	(80)
Northwest	22.8200	11.2829	0.6300	0.7000	0.7700	78.6882	(81)
Southeast	2.8800	39.9751	0.6300	0.7000	1.0000	45.6945	(82)
Northwest	2.8800	16.3666	0.6300	0.7000	1.0000	18.7082	(82)
Horizontal	1.4400	26.0000	0.6300	0.7000	1.0000	14.8599	(82)

Solar gains	604.5588	1085.1556	1621.8364	2222.9811	2672.9375	2730.9558	2600.9767	2255.5503	1829.5796	1237.2531	734.4473	510.5641	(83)
Total gains	1429.8827	1907.9624	2416.3476	2970.4118	3369.6655	3381.1517	3222.4322	2884.2276	2483.7514	1938.7623	1490.4701	1310.2599	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.6721	65.7959	65.9177	66.4960	66.6053	67.1189	67.1189	67.2149	66.9202	66.6053	66.3845	66.1552	
alpha	5.3781	5.3864	5.3945	5.4331	5.4404	5.4746	5.4746	5.4810	5.4613	5.4404	5.4256	5.4103	
util living area													
	0.9999	0.9994	0.9970	0.9820	0.9170	0.7606	0.5870	0.6691	0.9180	0.9949	0.9997	0.9999	(86)
MIT	19.6333	19.8034	20.0797	20.4449	20.7652	20.9433	20.9887	20.9782	20.8261	20.3945	19.9425	19.6068	(87)
Th 2	20.0357	20.0374	20.0390	20.0465	20.0480	20.0546	20.0546	20.0558	20.0520	20.0480	20.0451	20.0421	(88)
util rest of house													
	0.9999	0.9992	0.9958	0.9744	0.8825	0.6760	0.4689	0.5481	0.8690	0.9919	0.9995	0.9999	(89)
MIT 2	18.1767	18.4269	18.8319	19.3657	19.8051	20.0146	20.0501	20.0459	19.8953	19.2986	18.6362	18.1425	(90)
Living area fraction										fLA = Living area / (4) =		0.1953	(91)
MIT	18.4611	18.6957	19.0756	19.5765	19.9926	20.1960	20.2334	20.2280	20.0771	19.5126	18.8913	18.4285	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4611	18.6957	19.0756	19.5765	19.9926	20.1960	20.2334	20.2280	20.0771	19.5126	18.8913	18.4285	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9988	0.9941	0.9694	0.8801	0.6898	0.4920	0.5716	0.8706	0.9894	0.9992	0.9998	(94)
Useful gains	1429.5281	1905.6674	2402.1352	2879.5154	2965.7425	2332.1662	1585.4498	1648.5285	2162.2767	1918.3042	1489.3296	1310.0596	(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													
	6386.3683	6209.8619	5650.1864	4755.2073	3687.3954	2469.2518	1603.2780	1686.7160	2645.2688	3963.0762	5260.5589	6369.8631	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating kWh
3687.8891 2892.4187 2416.5500 1350.4982 536.9098 0.0000 0.0000 0.0000 0.0000 1521.3104 2715.2851 3764.4938 (98)
Space heating 18885.3552 (98)
Space heating per m2 (98) / (4) = 44.2819 (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)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 93.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 20198.2409 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3687.8891	2892.4187	2416.5500	1350.4982	536.9098	0.0000	0.0000	0.0000	0.0000	1521.3104	2715.2851	3764.4938	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	3944.2664	3093.4960	2584.5455	1444.3831	574.2351	0.0000	0.0000	0.0000	0.0000	1627.0699	2904.0482	4026.1966	(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													
	242.1276	213.4442	224.2393	201.1208	197.1680	176.2863	169.4083	185.7499	185.3769	208.5455	220.3834	236.3376	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.7585	89.6737	89.4812	88.9540	87.3540	79.8000	79.8000	79.8000	79.8000	89.0604	89.5981	89.7888	(217)
Fuel for water heating, kWh/month													
	269.7545	238.0233	250.5993	226.0953	225.7114	220.9102	212.2911	232.7693	232.3018	234.1620	245.9688	263.2149	(219)
Water heating fuel used												2851.8019	(219)
Annual totals kWh/year													
Space heating fuel - main system												20198.2409	(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)												895.3907	(232)
Total delivered energy for all uses												24020.4335	(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	20198.2409	0.2160	4362.8200	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2851.8019	0.2160	615.9892	(264)
Space and water heating			4978.8092	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	895.3907	0.5190	464.7078	(268)
Total CO2, kg/m2/year			5482.4420	(272)
Emissions per m2 for space and water heating			11.6742	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.0896	(272b)
Emissions per m2 for pumps and fans			0.0913	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.6742 * 1.55) + 1.0896 + 0.0913, rounded to 2 d.p.			19.2800	(273)

APPENDIX C - WATER CALCULATIONS

Part G Compliance Report

PROJECT DETAILS

Project Reference:
Client: Fitzpatrick Construction Ltd
Property: 38 Frognal Lane

London NW3 6PP

Local Authority: London Borough of Camden
Agent:

Assessor: Nicola Battista
Address: 7 The Stables, 32 George Lane, Plymouth, PL7 2JJ
Contact: 01752 337541

Software: G-Calc 2015 version 3.0.2
Prepared on: 07-Feb-20

RESULT SUMMARY

By following the Government's national calculation methodology for assessing water efficiency in new dwellings this 5 bed dwelling, as designed, achieves a water consumption of 104 litres per person per day.

Compliance with Building Regulation 36(1) has been demonstrated.

Key elements of the design include:
Rain water harvesting system apportioned 100% to this dwelling
BS8515 Intermediate approach adopted

Table 1: The Water Calculator for New Dwellings					
Installation Type	Unit of measure	Value	Use factor	Fixed use	litres/person/day
WC(single flush)	Flush volume (litres)	0	4.42	0.00	0
WC(dual flush)	Full flush vol.	0	1.46	0.00	0
	Part flush vol.	0	2.96	0.00	0
WC(multiple fittings)	Average effective Flush vol. (litres)	3.99	4.42	0.00	17.64
Taps(excl. Kitchen)	Flow rate (litres/min)	5	1.58	1.58	9.48
Bath (shower also present)	Capacity to overflow (litres)	173.33	0.11	0.00	19.07
Shower (bath also present)	Flow rate (litres/min)	12	4.37	0.00	52.44
Bath only	Capacity to overflow (litres)		0.50	0.00	0
Shower only	Flow rate (litres/minute)		5.6	0.00	0
Kitchen sink taps	Flow rate (litres/minute)	7.5	0.44	10.36	13.66
Washing Machine	litres/kg dry load	5	2.1	0.0	10.5
Dishwasher	litres/place setting	1	3.6	0.0	3.6
Waste disposal	litres/use	0	3.08	0.0	0
Water softener	litres/person/day	0	1.0	0.0	0

Total calculated use (litres/person/day)	126.39
Contribution from greywater (litres/person/day)	-
Contribution from rainwater (litres/person/day)	- 17.64
Normalisation factor	0.91
Total Water Consumption. Code for Sustainable Homes (litres/person/day)	**99**
External water use	5.0
Total Water Consumption. (36(1)) (litres/person/day)	**104**

Table 2: Consumption Calculator for multiple fittings for New Dwellings			
2.1: Taps (excluding kitchen sink taps)			
	Flow Rate (l/min)	Quantity (No.)	Total per fitting type
1 All basin taps	5	6	30
2			
3			
4			
Total (Sum of all Quantities)		6	
Total (Sum of all totals per fitting type)			30
Average Flow Rate (l/min)			5
Maximum Flow Rate (l/min)			5
Proportionate flow Rate (l/min)			3.5

Table 2: Consumption Calculator for multiple fittings for New Dwellings			
2.2: Baths			
	Capacity (litres)	Quantity (No.)	Total per fitting type
1 Bed 1 ensuite	180	1	180
2 Bed 2 ensuite	170	1	170
3 Bathroom	170	1	170
4			
Total (Sum of all Quantities)		3	
Total (Sum of all totals per fitting type)			520
Average Capacity to overflow (litres)			173.33
Maximum Capacity to overflow (litres)			180
Pproportionate capacity to overflow (litres)			126

Table 2: Consumption Calculator for multiple fittings for New Dwellings			
2.6: Showers			
Shower Type	Flow rate (l/min)	Quantity (No.)	Total per fitting type
1 All showers	12	5	60
2			
3			
4			
Total (Sum of all Quantities)		5	
Total (Sum of all totals per fitting type)			60
Average Flow rate (l/min)			12
Maximum Flow rate (l/min)			12
Proportionate flow rate (l/min)			8.4

Table 2: Consumption Calculator for multiple fittings for New Dwellings			
2.7: WC's			
WC Type	Effective flushing volume (litres)	Quantity (No.)	Total per fitting type
1 All WCs	3.99	6	23.94
2			
3			
4			
Total (Sum of all Quantities)		6	
Total (Sum of all totals per fitting type)			23.94
Average effective flushing volume (litres)			3.99

Table 5.1: Rainwater collection. BS8515 Intermediate approach	
Collection area (sqr. m)	112.4
Yeild co-efficient and hydraulic filter efficiency	0.7
Rainfall (average mm/year)	557
Daily rainwater collection (litres)	120.07
Number of occupants	6
Daily rainwater collected per person (litres)	20.01

Table 5.3: The rainwater demand calculations- WC's			
Effective flushing volume(litres)	Number of fittings present	Quantity using rainwater	Rainwater demand
3.99	6	6	23.94
		0	0
		0	0
		0	0
Total fittings consumption	6	Total rainwater demand	23.94
Average rainwater demand from WC's			17.64

Table 5.5: Rainwater saving calculation for New Dwellings	
	Litres per person per day
Rainwater collected	20.01
Rainwater demand	17.64
Rainwater savings	17.64

Rainwater use audit
Fittings using rainwater:
WC - All WCs

Summary of fitting types "As Designed"			
Type	Description	Flow rates, volumes etc.	Qty
Taps	All basin taps	5 litres/min	6
Baths	Bed 1 ensuite	180 litres to overflow	1
	Bed 2 ensuite	170 litres to overflow	1
	Bathroom	170 litres to overflow	1
Dishwashers		1 litres/place	1
Washing Machines		5 litres/kg	1
Showers	All showers	12 litres/min	5
WC's	All WCs	6 / 3 litres flush vols.	6
Kitchen/Utility taps	Kitchen tap	7.5 litres/min	1

The lower section of this table is to be filled in by the builder prior to completion. The descriptions, values and quantities should represent the 'as built' specification. Please note the values above represent design values and should not be exceeded without prior consultation with the agent/designer ().
The completed table should be returned to the assessor: Nicola Battista (Contact: 01752 337541).

Declaration of fitting types "As Built"			
Type	Make and Model	Flow rates, volumes etc.	Qty
Taps			
Baths			
Dishwashers			
Washing Machines			
Showers			
WC's			
Kitchen/Utility taps			

Project ref: - 38 Frognal Lane

The above declaration of fittings, values and quantities is a true reflection of those installed on this project.

Name: ..... Signature: ..... Date: .....

------End of Report------