Energy Strategy

OAKLEY GREEN LODGE, OAKLEY GREEN, WINDSOR

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Report Title	Energy Strategy		
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Revision	**Date**	**Description**	**Prepared by**	**Checked by**
1.0	15.01.2024	For PP	Naomi Sadler	Jayne Dakin
2.0	16.01.2024	Image 1 - Site Plan updated	Jayne Dakin	Naomi Sadler

About Sadler Energy and Environmental Services Ltd.

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry from the concept and planning stage through to the completion of the project.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for energy efficiency, quality and practical on-site applications.

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Executive Summary

This document presents a strategic energy report for the development located at Oakley Green Lodge, Windsor, comprising four houses, along with landscaping, car parking, and associated works.

The report evaluates the anticipated energy performance of the proposed development and outlines design measures to mitigate CO2 emissions. In alignment with the Royal Borough of Windsor & Maidenhead interim sustainability position statement (March 2021), which requires a minimum 20% reduction of Dwelling Emission Rate (DER) against the Target Emission Rate (TER), the energy strategy advocates a fabric-first approach. This prioritises enhancing the dwelling envelope before exploring on-site energy generation.

The developer's proposal includes two options:

1. Air source heat pumps to all plots, surpassing the mandated 20% reduction in carbon emissions beyond the Part L 2012 baseline.
2. Further consideration is given to additional photovoltaic panels to enhance carbon savings.

As the development progresses, options and sizing adjustments for the heat pump will be explored to maximise carbon savings. Both options provide at least a 40% improvement over building regulations.

Designed to SAP 2021 standards, the project complies with all three metrics under the new building regulations and meets planning requirements. It's essential to note that the calculations and specifications outlined in this assessment are subject to modification as the site's design advances, while the overarching targets will be accomplished.

Information and Background

This Energy Strategy aims to outline the measures and technologies essential for surpassing the standards set by The Royal Borough of Windsor & Maidenhead. Its primary goal is to guarantee that homes not only fulfil the local requirements but also contribute to diminishing dependence on fossil fuels. The strategy further strives to minimise carbon emissions associated with new developments, thereby slowing the progression of climate change. The specified site encompasses four four-bedroom houses.

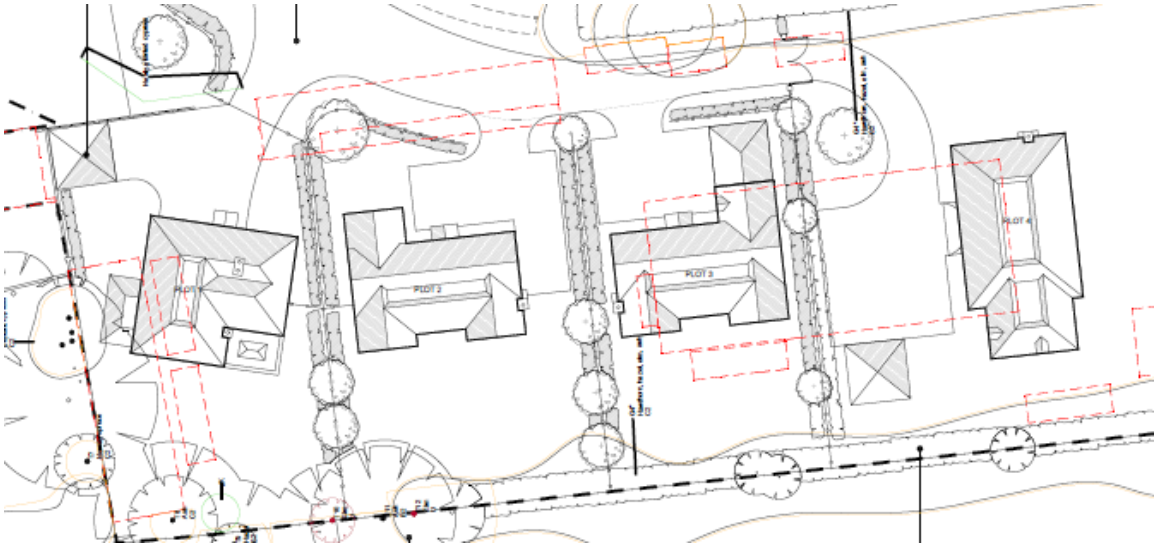


Image 1 – Site Plan

1. Planning Targets

The Royal Borough of Windsor & Maidenhead Borough Local Plan (BLP) was adopted in February 2022 and sets measures to respond to the declared climate emergency. Policy SP 2 details what measures developments should incorporate to adapt to and mitigate climate change:

Policy SP 2

Climate Change

1. *All developments will demonstrate how they have been designed to incorporate measures to adapt to and mitigate climate change. The following measures shall be incorporated into development:*
    a. *Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;*
    b. *Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;*
    c. *Use of trees and other planting, where appropriate as part of green and blue infrastructure schemes, to provide shading of amenity areas, buildings, and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and*
    d. *All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change.*
2. *Adaptation measures need to be built into all new developments to ensure the sustainable development of housing, businesses, and the economy of the Royal Borough.*
3. *Applicants should refer to the adopted Sustainable Design and Construction Supplementary Planning Document (SPD), the Borough Wide Design Guide SPD and the Environment and Climate Strategy 2020-2025, or successor documents for further guidance.*

The 'Position Statement on Sustainability and Energy Efficient Design' was published in March 2021 and clarifies how the Local Planning Authority will interpret policies in the handling of planning applications, it also sets out how the council will ensure compliance with adopted planning policy, the NPPF and national commitments relating to climate change. The guidance states:

A. *All Development proposals (except householder residential extensions and non-residential development with a floorspace of below 100sq.m) should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:*
    1. *Be lean: use less energy*
    2. *Be clean: supply energy efficiently*
    3. *Be green: use renewable energy*
B. *All developments (except householder residential extensions and non-residential development with a floorspace of below 100sq.m) should be net-zero carbon unless it is demonstrated this would not be feasible.*

C. *All development proposals except householder residential extensions and non-residential development with a floorspace of below 100sq.m) should include a detailed energy assessment and a completed Carbon Reporting Spreadsheet to demonstrate how the net-zero target will be met*
D. *Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies. There is an expectation that developments maximise renewable energy generation regardless of whether minimum standards are met through other measures, as such there is an expectation 12% of the total energy demand will be met by on-site renewables, unless this is demonstrated to be unfeasible.*
E. *Proposals for the storage and use or export of excess energy arising from renewable energy technologies.*

(Note - Buildings which do not achieve at least a 20% reduction of the Dwelling Emission Rate (DER)/Building Emission Rate (BER) against the Target Emission Rate (TER) based on the Building Regulations Part L 2013 and defined within the Standard Assessment Procedure (SAP) calculation model will not be acceptable.)

This report will demonstrate workings towards Windsor & Maidenhead zero-carbon ambition and 20% reduction on TER in SAP 10 calculations, with aim to achieve zero-carbon.

2. Energy Efficiency

Energy efficiency and carbon emission rates have been calculated using SAP10, which produces metrics used for Building Regulations compliance, based on the predicted annual energy use per square meter of floor area for a dwelling, The metrics used in this report are:

- Dwelling Emissions Rate (DER): the predicted carbon dioxide emissions based on the fuels used to heat, light, cool and ventilate a dwelling, expressed in kgCO2/m2/yr.
- Dwelling Fabric Energy Efficiency: the predicted energy used to heat and cool a dwelling expressed in kWh/m2/yr.

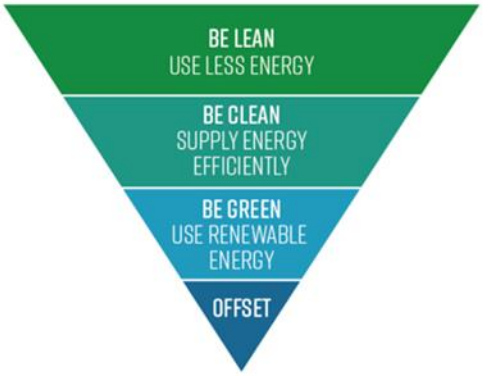
For each metric, a "target" is calculated by SAP based on a notional dwelling specification set in the Building Regulations. The dwelling energy metrics must be lower than these targets to achieve Building Regulation Part L compliance.

This energy strategy will outline carbon emission savings through fabric-first approaches and renewable technology options, with the aim to achieve low and zero carbon dwellings. Each option will be modelled in SAP and produce percentage savings on dwelling emission rates (DER) for properties vs target emission rates (TER), and percentage savings on dwelling fabric energy efficiency (DFEE) vs target dwelling fabric energy efficiency (TFEE).

2.1 Methodology

This report uses the energy hierarchy to minimise onsite carbon emissions, the stages are:

- Use Renewable Energy – assess the feasibility of renewable energy systems.
- Supply Energy Efficiently – Use low-carbon technology to significantly reduce energy consumption.
- Use less Energy – the incorporation of low energy design and passive measures to promise the reduction of energy use



Indicative calculations have also been carried out using the SAP 2021 carbon emissions for each fuel type. This is intended to demonstrate that the proposals remain consistent with the expectation of both current and future regulations.

2.2 Building Energy Modelling

The site was simulated using SAP2012 to adhere to the planning requirements of the Royal Borough of Windsor & Maidenhead Borough. Additionally, SAP2021 was employed to ensure compliance with building regulations and facilitate calculations for carbon offset payments (refer to SAP summary). This modelling process aimed to forecast energy requirements and CO2 emissions, aligning with the stipulations of the planning policy.

3.0 Energy Efficiency

In order to deliver the energy demand reduction required to meet and exceed Part L 2021 compliance, improvements to the fabric specification and heating systems of the dwellings forms the first stage of the energy hierarchy.

A fabric first approach has been adopted to minimise energy demand as much as practical. Energy efficiency features that were proposed include: Built form, Insulation standards, Glazing, Heating systems, Ventilation, Lighting, Controls, Heat recovery, Free cooling, and Equipment. In this chapter we have detailed the most effective energy efficient measures.

Three main sources of heat loss:

- Thermal Envelope
- Thermal Bridging
- Uncontrolled Air Leakage

3.1 Thermal Envelope

Table 1 summarises the proposed performance of the thermal envelope. It is proposed that all areas significantly improve upon the minimum building fabric standards stated within BR Part L 2021.

Thermal Element	BR U-value(Part L 2021) W/m²K	Proposed Target values W/m²K	% Improvement Over Building Regulations 2021
Ground Floor	**0.18**	**0.11-0.12**	**38.89%**
External wall	**0.26**	**0.19**	**26.92%**
Flat Roof	**0.16**	**0.15**	**6.25%**
Warm Roof	**0.16**	**0.09**	**43.75%**
External Doors	**1.6**	**1.2**	**25%**
Windows & Glazed Doors	**1.6**	**1.2**	**25%**

Table 1 - Proposed Fabric Standard

These proposed U-values show more an improvement on BR 2021 standards and are conducive to energy efficiency within built form and insulation standards.

3.2 Thermal Bridging

Thermal bridging occurs at the junction between fabric elements, where the continuous insulation line is broken. Through careful detailing of junctions, it is possible to mitigate against the impact of thermal bridges.

Wesbourne Homes standard details ensure that the design of junctions minimises unnecessary bridging of the insulation layers, with avoidable heat loss being reduced wherever possible. Accurate calculation of these heat losses forms an integral part of the SAP calculations undertaken to establish energy consumption of the dwellings, and as such thermal modelling has been undertaken to assess the performance of all main building junctions. An overall average Y-value of approximately 0.070 is achieved for the sample of units modelled, compared with a SAP default value of 0.150.

The dwellings on this development aim for minimal thermal bridging, with thermal bridging for all blocks well below BR 2021, see Table 2.

Junction With	Bridge Type		DEFAULT Ψ [w/mk]	Oakley Green Lodge Ψ [w/mk]
External Wall	E2	Lintels	1.0	0.029
External Wall	E3	Sill	0.1	0.046
External Wall	E4	Jamb	0.1	0.051
External Wall	E5	Ground floor (normal) Suspended Beam and block	0.32	0.056

External Wall	E6	Intermediate floor within a dwelling (timber)	0.14	0.00
External Wall	E7	Party floor between dwellings (Medium Block)	0.28	0.053
External Wall	E20	Exposed Floor (normal)	0.32	0.15
External Wall	E10	Eaves (Insulation at ceiling level)	0.12	0.053
External Wall	E12	Gable (insulation at ceiling level)	0.25	0.037
External Wall	E13	Gable (insulation at rafter level)	0.25	0.080
External Wall	E14	Flat Roof (With Parapet)	0.30	0.043
External Wall	E16	Corner	0.18	0.041
External Wall	E17	Corner (inverted)	0	-0.066

Table 2 – Thermal Bridging at Oakley Green

3.3 Uncontrolled Air Leakage and Ventilation

As buildings become more insulated, uncontrolled air leakage represents an increasing proportion of dwelling heat loss. As such, it is critical to ensure that any unwanted leakage is minimised. Table 3 details ventilation at Oakley Green Lodge, including air tightness and air permeability for each block.

Under current Building Regulations (2021) a dwelling must have an infiltration rate of less than 8m3/hm2@50Pa. The air permeability targets for Oakley Green Lodge will vary for each building type and will be much lower than 8, as seen in Table 3.

Building	Houses
Air Permeability (m^3/hm^2 50Pa)	**4.0**

Table 3 - Air permeability

3.4 Lighting

Low energy fittings are defined as fittings that can only be used with lamps having a luminous efficacy greater than 80 lumens per circuit watt. All buildings will have 100% low energy lights fitted internally.

Externally, property will have low energy light fitting or standards with light and motion sensors.

3.5 Primary Energy

Heat generation and distribution systems will be designed to give the occupants a high level of control over their use, encouraging and allowing energy-efficient behaviour.

The heating system will be designed, at a maximum flow temperature of 55°C or lower with full zone control to occupants. Two heating systems are modelled further within this report for consideration:

- **Option 1** - Air Source Heat Pumps. Time and temperature zoning controls will be included with fully insulated primary pipework being installed throughout.
- **Option 2** – Air Source Heat Pumps. Time and temperature zoning controls will be included with fully insulated primary pipework being installed throughout with PV to model the reduction in the carbon offset payment

The heating systems are considered further under Section 4 of this report.

3.6 Passive Design Measures and Overheating Risk Mitigation

In order to further reduce energy demand, where practical dwellings have been designed with regard to the principles of passive design, including consideration of building orientation and site placement to maximise the potential for solar gain.

Materials with high thermal inertia – including traditional masonry construction – take a number of hours to warm up in the conditions normally associated with the interior of domestic properties. By slowly extracting heat from the air inside a dwelling, they offer a heat sink and reduce overheating risk. The heat absorbed is then emitted during the night, offering a small amount of passive heating. The overall effect serves to smooth out the heat profile within the dwelling thus reducing the need for instantaneous heating and cooling.

Further passive and active design measures to reduce energy demand and balance internal and external heat gains include:

- Specifying glazing with a solar transmittance value (g-value) that has been carefully considered to strike the balance between useful solar gain in the winter and unwanted solar gain in the summer, 0.50 G-Value has been specified on this development within the overheating Part O assessment.
- Minimising overshading from adjacent dwellings and vegetation.
- Specifying highly insulated hot water cylinders where required, with low heat loss values.
- Fully insulating all primary pipework.
- Installing energy efficient lighting, a minimum of 80 l/w is specified on this development.

Due to the measures described to reduce internal heat gain, natural ventilation provided through window openings and the opportunity for cross ventilation will allow sufficient air exchange rates to purge any heat build-up. Active cooling systems are therefore not proposed.

These measures will serve to ensure that the development builds in resilience to a potentially changing climate over the lifetime of the buildings and minimises the overheating risk that can be exacerbated by the drive to better insulated, more airtight homes if not considered within the design and construction process.

3.7 Water Usage

To minimise onsite usage of potable water it is proposed that all dwellings will aspire to achieve a minimum water efficiency standard of 105 litres/person/day. It is recommended that maximum water consumption criteria, as stated in table 2.2 of approved document Part G be followed, summarised in Table 4. This would have achieved a Code for Sustainable Homes rating of Level 4 if the scheme were still active.

Water Fitting	Maximum Consumption
WC	4/2.6 litres dual flush
Shower	8 l/min
Bath	170 litres
Basin Taps	3 l/min
Sink Taps	6 l/min
Dishwasher	1.25 l/place setting
Washing Machine	8.17 l/kilogram dry load

Table 4: (Part G2 Table 2.2) Maximum fittings consumption optional requirement level

4 Energy Efficiency Low and Zero Carbon (LZC) Energy Generation and Results

Space heating demand will be low, and the greater energy demand will be for hot water. In line with the phasing out of gas as the main form of energy for heating and hot water and the Decarbonisation of the National Grid, electricity will be used for space and hot water. Space heating and hot water will be provided an air source heat pump, which combines hot water and space heating.

4.1 Air Source Heat Pumps - OPTION 1

ASHPs use an external heat exchanger unit to extract heat from the ambient air and can continue to operate at negative external air temperatures although the CoP achieved will reduce at lower temperatures. The heat exchanger unit needs to be in free air externally and would typically be installed on a ground plinth or wall-mounted, the fan may also produce an audible low hum in operation, for these reasons it is important to consider a suitable installation location accordingly.

The proposed development consists of low-density housing with each property benefiting from a private garden with the exceptions of the apartments, further consideration will need to be given to consider this technology within the apartments.

For the supporting calculations, a Valient air source heat pump has been modelled, at design stage detail sizing of the heat pump will be required to ensure that heating capacity matches expected peak heating demand.

In conjunction with additional energy efficiency and renewable measures this system can achieve the over 40% reduction in carbon emissions compared to the expected requirements of the upcoming SAP 10.1 methodology.

4.1.1 Considerations

Air Source Heat Pumps	
Potential Advantages	**Risks & Disadvantages**
▲ The technology offsets the high carbon content of grid supplied electricity used for lighting, pumps and fans, appliances and equipment. ▲ Average carbon saving of 65% compared to gas boilers. ▲ Typically, a traditional gas boiler lasts up to around 15 years and will become less efficient as time goes on and will have to work harder to heat your home. A well-maintained air source heat pump could last up to 20 years. ▲ Heat pumps require electricity to run, but they use the electricity more efficiently than other heating systems, with a typical heat pump using only about a quarter of the energy needed for a traditional gas boiler. ▲ Significantly lower emissions when calculated	▲ Poor design and installation can lead to lower-than-expected yields (e.g. from shaded locations) ▲ The heat pump unit needs to sit on the outside wall of your property and needs to have enough space around it so that the air can effectively be drawn into the unit. This could possibly be an issue for some people who may have limited space around their homes. ▲ Safe access must be considered for maintenance and service checks.

using updated SAP 10.1 emissions factors	
Conclusion	
Air Source Heat Pumps will surpass the 20% target over TER could be suitable for the dwelling but need to be considered further	

4.1.2 Energy and CO2 Savings for ASHPs

Westbourne Homes are considering the use of air source heat pumps to address the requirements of SC4. Calculations undertaken to assess the as-designed performance after demand reduction measures demonstrated that the dwellings reduce carbon emissions by a minimum 40% over Part L 2012 requirements.

Table 5 below summarises the total energy reduction due to renewable technology over the development.

House Type	Number Of units	TER	DER	% Improvement
Plots 1	1	21.71	10.79	50.30%
Plot 2	1	21.28	10.38	51.12%
Plot 3	1	21.36	10.44	51.12%
Plot 4	1	21.01	10.67	49.21%
Site Wide	**4**	**21.34**	**10.57**	**50.47%**

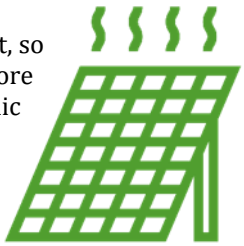
Table 5 – Option 2 ASHP Improvement over building regulations under SAP 2012

The ASHP alternative exceeds the 20% target beyond the TER, achieving over 40% improvement in all plots according to the 2012 Building Regulation, as mandated by the planning policy of the Royal Borough of Windsor & Maidenhead Borough Council. When evaluated in SAP 10, this performance results in a cash-in-lieu offset payment of £24,066, as illustrated in Table 6 below.

Plot	Carbon dioxide emissions (t. CO2 per annum)					
	Regulated		Regulated Carbon dioxide savings			
	Baseline: Part L 2021 of Building Regulations Compliant Development (TER)	Be Lean, Clean and Green: After energy demand reduction (DER)	Savings from energy demand reduction	Savings from energy demand reduction	Annual Savings from off-set payment	Cash-in-lieu contribution
	A		= A - B	C	= C x 30 = D	= D x Carbon dioxide offset price (£60.00) = E
Plot 1	7.84	3.08	4.8	3.1	92.4	£ 5,544.00
Plot 2	8.28	3.04	5.2	3.0	91.2	£ 5,472.00
Plot 3	8.31	3.06	5.3	3.1	91.8	£ 5,508.00
Plot 4	7.72	2.96	4.8	3.0	88.8	£ 5,328.00
					Total Site Contribution	**£ 21,852.00**

Table 6: GLA 2016 ENERGY ASSESSMENT SAP 10 Carbon off set payment ASHP OPTION 1

4.2 Photovoltaic Panels - OPTION 2



Photovoltaic panels convert energy from sunlight into electricity. They work in daylight, so do not require direct sunlight and are suitable for cloudy climate of the UK. However more energy will be produced in direct sunlight and in very shady positions on the photovoltaic panel will not function.

PV depends on the orientation of properties, roof pitch and weather on the level of efficiency achieved. The biggest barrier is cost but to offset these costs the government are offering small grants to assist with the purchasing cost of the PV system. Consideration as to the type of buildings the PV cells are put onto in view of the high initial cost and to optimise on the efficiency of the PV array. The PV systems are most efficient during the day, all year. Domestic properties do not fully benefit from this as the demand in the early morning and evening when the PV Cells are least efficient.

4.2.1 Site Assessment

The assessment of the development has been aligned with the proposed fabric specification. Additionally, an alternative version of the ASHP options was examined to showcase the potential savings resulting from the addition of 1 kWp of PV to each dwelling. The outcomes indicate that incorporating 4 kWp of PV across the entire development leads to a saving of £2,214.00 in the offset payment, providing an option for the developer. As the development advances through the technical stages, this option will be further evaluated and considered.

Plot	Carbon dioxide emissions (t. CO2 per annum)					
	Regulated		Regulated Carbon dioxide savings			
	Baseline: Part L 2021 of Building Regulations Compliant Development (TER)	Be Lean, Clean and Green: After energy demand reduction (DER)	Savings from energy demand reduction	Savings from energy demand reduction	Annual Savings from off-set payment	Cash-in-lieu contribution
	A		= A - B	C	= C x 30 = D	= D x Carbon dioxide offset price (£60.00) = E
Plot 1	7.84	3.08	4.8	3.1	92.4	£ 5,544.00
Plot 2	8.28	3.04	5.2	3.0	91.2	£ 5,472.00
Plot 3	8.31	3.06	5.3	3.1	91.8	£ 5,508.00
Plot 4	7.72	2.96	4.8	3.0	88.8	£ 5,328.00
					Total Site Contribution	**£ 21,852.00**

Table 7: GLA 2016 ENERGY ASSESSMENT SAP 10 Carbon off set payment ASHP and PV OPTION 2

4.2.2 Considerations

Solar Photovoltaic	
Potential Advantages	**Risks & Disadvantages**
▲ The technology offsets the high carbon content of grid supplied electricity used for lighting, pumps and fans, appliances, and equipment ▲ Mature and well proven technology that is relatively easily integrated into building fabric ▲ Solar resource is not limited by energy loads of the dwelling as any excess generation can be transferred to the national grid ▲ PV systems generally require very little maintenance ▲ Significantly lower emissions when calculated using updated SAP 10.1 emissions factors	▲ Poor design and installation can lead to lower than expected yields (e.g. from shaded locations) ▲ Installation is restricted to favourablee orientations ▲ Occupiers may not benefit from Feed in Tariff payments where the contract is held by a landlord ▲ Safe access must be considered for maintenance and service checks ▲ Visual impact may be a concern in special landscape designations (e.g. AONB) ▲ Reflected light may be a concern in some locations
Conclusion	
PV panels are considered technically feasible, and should be positioned to make use of favourablee roof orientations to maximise energy generation	

5 Conclusion

The Royal Borough of Windsor & Maidenhead Borough Council mandates that developments must achieve a 20& reduction in emissions beyond 2012 building regulations, the development achieved a minimum 50% decrease in carbon emissions achieved through energy-efficient design and on-site renewable energy, surpassing the planning requirement of 20%.

Energy strategy options were evaluated using SAP 2021 calculations, which adhere to more stringent carbon emission limits. Through extrapolation of sample SAPs, the analysis reveals that Oakley Green Lodge scheme exceeds the council's ambition to move towards carbon reduction of at least 20%. This is achieved by prioritising a fabric-first approach that surpasses building regulations and further reducing emissions through the integration of renewable technologies within the development.

The report presents three viable options for the development:

1. Air Source Heat Pumps for all dwellings with a £24,066.00 carbon offset payment.
2. Air Source Heat Pumps for all dwellings with 1 kWp of PV with £21,852.00.00 carbon offset payment.

As the development advances, it is evident that both options align seamlessly with the council's commitment to reducing emissions. The heating systems will undergo thorough evaluation to ensure appropriate sizing and technical compliance. Consequently, the site is poised to meet the stipulations of The Royal Borough of Windsor & Maidenhead Borough Council planning policy.

APPENDIX A – SAP 2012

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

Property Reference	P1 Oak	**Issued on Date**	16/01/2024
Assessment Reference	P1 Oak	**Prop Type Ref**	End
Property	1, Oakley		

SAP Rating	86 B	**DER**	10.79	**TER**	21.71
Environmental	88 B	**% DER<TER**	50.29		
CO_2 Emissions (t/year)	2.73	**DFEE**	45.37	**TFEE**	59.39
General Requirements Compliance	Pass	**% DFEE<TFEE**	23.61		

Assessor Details	Mrs. Naomi Sadler, Sadler Energy & Environmental Services Ltd, Tel: 01962 718870, naomi.sadler@sadlerenergy.co.uk	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne		

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	166.3600	(1b)	x 2.9300	(2b) =	487.4348	(1b) - (3b)
First floor	134.2600	(1c)	x 2.4000	(2c) =	322.2240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		809.6588	(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) =	0.0865	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2865	(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) =	0.2650	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2782	0.2650	0.2650	0.2451	0.2451	0.2186	0.2252	0.2120	0.2186	0.2319	0.2319	0.2517	(22b)
Effective ac	0.5387	0.5351	0.5351	0.5300	0.5300	0.5239	0.5254	0.5225	0.5239	0.5269	0.5269	0.5317	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3600	0.1100	18.2996	0.0000	0.0000	(28a)
External Wall 1	246.6800	54.5400	192.1400	0.1900	36.5066	60.0000	11528.4000	(29a)
External Wall 2	32.2900	1.9200	30.3700	0.1800	5.4666	190.0000	5770.3000	(29a)
External Roof 1	152.2000		152.2000	0.0900	13.6980	9.0000	1369.8000	(30)
External Roof 2	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
Total net area of external elements Aum(A, m2)			611.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		141.7808			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			53.3000			18.0000	959.4000	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31141.1400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		103.5897 (35)
Thermal bridges (User defined value 0.037 * total exposed area)		22.6325 (36)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 164.4133 (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	143.9347	142.9733	142.9733	141.6191	141.6191	139.9777	140.3705	139.5967	139.9777	140.7750	140.7750	142.0588	(38)
Heat transfer coeff	308.3481	307.3866	307.3866	306.0325	306.0325	304.3910	304.7838	304.0100	304.3910	305.1883	305.1883	306.4721	(39)
Average = Sum(39)m / 12 =												305.8009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0257	1.0225	1.0225	1.0180	1.0180	1.0125	1.0139	1.0113	1.0125	1.0152	1.0152	1.0195	(40)
HLP (average)												1.0172	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1327 (42)

Average daily hot water use (litres/day) 108.6025 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	119.4627	115.1186	110.7745	106.4304	102.0863	97.7422	97.7422	102.0863	106.4304	110.7745	115.1186	119.4627	(44)
Energy conte	177.1598	154.9451	159.8894	139.3955	133.7533	115.4189	106.9526	122.7297	124.1954	144.7378	157.9926	171.5698	(45)
Energy content (annual)										Total = Sum(45)m =		1708.7399	(45)
Distribution loss (46)m = 0.15 x (45)m	26.5740	23.2418	23.9834	20.9093	20.0630	17.3128	16.0429	18.4094	18.6293	21.7107	23.6989	25.7355	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
									Total per year (kWh/year) = Sum(64)m =			2317.7059	(64)
RHI water heating demand												2318	(64)
Heat gains from water heating, kWh/month	100.2819	88.8914	94.5396	86.3906	85.8493	78.4184	76.9381	82.1839	81.3366	89.5016	92.5742	98.4233	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	112.4612	99.8870	81.2336	61.4991	45.9713	38.8109	41.9365	54.5107	73.1641	92.8987	108.4265	115.5868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	684.7259	691.8312	673.9261	635.8081	587.6910	542.4678	512.2558	505.1505	523.0557	561.1736	609.2907	654.5140	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	(71)
Water heating gains (Table 5)	134.7876	132.2789	127.0693	119.9869	115.3888	108.9144	103.4114	110.4623	112.9675	120.2979	128.5752	132.2893	(72)
Total internal gains	1051.5586	1043.5810	1001.8128	936.8780	868.6350	809.7769	777.1876	789.7074	828.7712	893.9541	965.8763	1021.9741	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	11.9814	0.7200	0.7000	0.7700	3.6408	(74)
East	12.2400	22.3313	0.7200	0.7000	0.7700	95.4684	(76)
South	3.6600	50.9848	0.7200	0.7000	0.7700	65.1757	(78)
West	20.8200	22.3313	0.7200	0.7000	0.7700	162.3898	(80)

Solar gains	326.6747	555.8489	867.8441	1262.6991	1482.8626	1615.7002	1524.9525	1355.2812	1078.1677	692.8238	413.0750	268.8136	(83)
Total gains	1378.2332	1599.4299	1869.6570	2199.5771	2351.4976	2425.4771	2302.1402	2144.9885	1906.9388	1586.7779	1378.9513	1290.7877	(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	28.0537	28.1415	28.1415	28.2660	28.2660	28.4184	28.3818	28.4541	28.4184	28.3442	28.3442	28.2255
alpha	2.8702	2.8761	2.8761	2.8844	2.8844	2.8946	2.8921	2.8969	2.8946	2.8896	2.8896	2.8817

CALCULATION OF HEAT DEMAND 09 Jan 2014

util living area

	0.9810	0.9703	0.9428	0.8766	0.7573	0.5550	0.3914	0.4272	0.7139	0.9103	0.9687	0.9839 (86)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104
Tweekend	19.8939	20.0016	20.2269	20.5060	20.7427	20.8880	20.9270	20.9233	20.8204	20.5189	20.1620	19.8764
24 / 16	8	0	0	0	0	0	0	0	0	0	0	0
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0
16 / 9	2	20	7	0	0	0	0	0	0	0	0	22
MIT	20.8930	20.0016	19.9404	20.2287	20.6029	20.8279	20.8873	20.8817	20.7196	20.2575	19.6916	19.8764 (87)
Th 2	20.0620	20.0646	20.0646	20.0684	20.0684	20.0729	20.0718	20.0739	20.0729	20.0707	20.0707	20.0671 (88)

util rest of house

	0.9779	0.9655	0.9330	0.8544	0.7108	0.4725	0.2819	0.3140	0.6440	0.8891	0.9626	0.9813 (89)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104
Tweekend	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104
MIT 2	19.8379	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104 (90)
Living area fraction										fLA = Living area / (4) =		0.2814 (91)
MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198 (92)
Temperature adjustment												0.0000
adjusted MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9553	0.9176	0.8361	0.7005	0.4791	0.2973	0.3295	0.6407	0.8717	0.9508	0.9745	(94)
Useful gains	1348.1725	1527.9258	1715.5930	1839.1529	1647.1819	1162.0467	684.4114	706.7415	1221.8617	1383.2705	1311.0532	1257.8345	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4635.9232	3982.3835	3534.9710	2914.2964	2106.8130	1260.9166	700.1478	728.0826	1471.4866	2398.8463	3275.3098	4051.5072	(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													
	2446.0865	1649.3955	1353.6173	774.1033	341.9655	0.0000	0.0000	0.0000	0.0000	755.5884	1414.2647	2078.4924	(98)
Space heating												10813.5136	(98)
RHI space heating demand												10814	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	166.3600	(1b)	x 2.9300	(2b) =	487.4348	(1b) - (3b)
First floor	134.2600	(1c)	x 2.4000	(2c) =	322.2240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		809.6588	(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) =	0.0865	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2865	(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) =	0.2650	(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	0.3378	0.3312	0.3246	0.2915	0.2848	0.2517	0.2517	0.2451	0.2650	0.2848	0.2981	0.3113	(22b)
Effective ac	0.5571	0.5549	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3600	0.1100	18.2996	0.0000	0.0000	(28a)
External Wall 1	246.6800	54.5400	192.1400	0.1900	36.5066	60.0000	11528.4000	(29a)
External Wall 2	32.2900	1.9200	30.3700	0.1800	5.4666	190.0000	5770.3000	(29a)
External Roof 1	152.2000		152.2000	0.0900	13.6980	9.0000	1369.8000	(30)
External Roof 2	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
Total net area of external elements Aum(A, m2)			611.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		141.7808			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			53.3000			18.0000	959.4000	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31141.1400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		103.5897 (35)
Thermal bridges (User defined value 0.037 * total exposed area)		22.6325 (36)
Total fabric heat loss	(33) + (36) =	164.4133 (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	148.8415	148.2494	147.6690	144.9431	144.4330	142.0588	142.0588	141.6191	142.9733	144.4330	145.4648	146.5435	(38)
Heat transfer coeff	313.2548	312.6627	312.0823	309.3564	308.8464	306.4721	306.4721	306.0325	307.3866	308.8464	309.8781	310.9568	(39)
Average = Sum(39)m / 12 =												309.3539	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0420	1.0401	1.0381	1.0291	1.0274	1.0195	1.0195	1.0180	1.0225	1.0274	1.0308	1.0344	(40)
HLP (average)												1.0291	(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		3.1327 (42)
Average daily hot water use (litres/day)		108.6025 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	119.4627	115.1186	110.7745	106.4304	102.0863	97.7422	97.7422	102.0863	106.4304	110.7745	115.1186	119.4627	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	177.1598	154.9451	159.8894	139.3955	133.7533	115.4189	106.9526	122.7297	124.1954	144.7378	157.9926	171.5698	(45)
Energy content (annual)										Total = Sum(45)m =		1708.7399	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.5740	23.2418	23.9834	20.9093	20.0630	17.3128	16.0429	18.4094	18.6293	21.7107	23.6989	25.7355	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
									Total per year (kWh/year) = Sum(64)m =			2317.7059	(64)
Heat gains from water heating, kWh/month													
	100.2819	88.8914	94.5396	86.3906	85.8493	78.4184	76.9381	82.1839	81.3366	89.5016	92.5742	98.4233	(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	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	112.4612	99.8870	81.2336	61.4991	45.9713	38.8109	41.9365	54.5107	73.1641	92.8987	108.4265	115.5868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7259	691.8312	673.9261	635.8081	587.6910	542.4678	512.2558	505.1505	523.0557	561.1736	609.2907	654.5140	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	(71)
Water heating gains (Table 5)													
	134.7876	132.2789	127.0693	119.9869	115.3888	108.9144	103.4114	110.4623	112.9675	120.2979	128.5752	132.2893	(72)
Total internal gains													
	1051.5586	1043.5810	1001.8128	936.8780	868.6350	809.7769	777.1876	789.7074	828.7712	893.9541	965.8763	1021.9741	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1341.3393	1591.2744	1867.5969	2160.2002	2344.0562	2312.1932	2210.6374	2035.0163	1821.3609	1533.2918	1323.4780	1262.8068	(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	27.6143	27.6666	27.7181	27.9623	28.0085	28.2255	28.2255	28.2660	28.1415	28.0085	27.9152	27.8184	
alpha	2.8410	2.8444	2.8479	2.8642	2.8672	2.8817	2.8817	2.8844	2.8761	2.8672	2.8610	2.8546	
util living area													
	0.9844	0.9738	0.9511	0.9005	0.8113	0.6786	0.5429	0.5950	0.7955	0.9335	0.9761	0.9868	(86)
Tweekday	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
Tweekend	19.7938	19.9181	20.1331	20.4106	20.6538	20.8239	20.8959	20.8816	20.7415	20.4154	20.0529	19.7714	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	22	0	0	0	0	0	0	0	0	0	0	1	
16 / 9	0	20	7	0	0	0	0	0	0	0	0	21	
MIT	21.0000	19.9181	19.8120	20.0796	20.4657	20.7295	20.8394	20.8173	20.5963	20.0977	19.5212	19.8110	(87)
Th 2	20.0485	20.0501	20.0517	20.0592	20.0606	20.0671	20.0671	20.0684	20.0646	20.0606	20.0577	20.0548	(88)
util rest of house													
	0.9819	0.9697	0.9431	0.8832	0.7761	0.6141	0.4486	0.5023	0.7445	0.9184	0.9716	0.9847	(89)
Tweekday	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
Tweekend	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
MIT 2	20.0485	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.5484	(90)
Living area fraction										fLA = Living area / (4) =		0.2814	(91)
MIT	20.3162	18.3900	18.7069	19.2266	19.7104	20.0325	20.1521	20.1327	19.8866	19.2471	18.5016	18.1850	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3162	18.3900	18.7069	19.2266	19.7104	20.0325	20.1521	20.1327	19.8866	19.2471	18.5016	18.1850	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9601	0.9285	0.8646	0.7611	0.6115	0.4578	0.5092	0.7332	0.9018	0.9615	0.9790	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	1318.0291	1527.8541	1733.9760	1867.6103	1783.9793	1413.8482	1011.9761	1036.3198	1335.3482	1382.6479	1272.4583	1236.3156	(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	5017.1434	4217.8259	3809.5474	3194.6083	2473.9743	1664.9142	1088.6319	1142.3186	1778.7386	2670.6239	3533.1208	4348.7254	(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	2752.1410	1807.6611	1544.2251	955.4386	513.3563	0.0000	0.0000	0.0000	0.0000	958.2541	1627.6770	2315.6329	(98)
Space heating												12474.3861	(98)
Space heating per m2											(98) / (4) =	41.4955	(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 %)												297.8903	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4187.5771	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2752.1410	1807.6611	1544.2251	955.4386	513.3563	0.0000	0.0000	0.0000	0.0000	958.2541	1627.6770	2315.6329	(98)
Space heating efficiency (main heating system 1)	297.8903	297.8903	297.8903	297.8903	297.8903	0.0000	0.0000	0.0000	0.0000	297.8903	297.8903	297.8903	(210)
Space heating fuel (main heating system)	923.8774	606.8211	518.3872	320.7350	172.3306	0.0000	0.0000	0.0000	0.0000	321.6802	546.4015	777.3442	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.6841	73.7318	77.3696	69.2666	67.8136	60.5001	58.0147	63.7831	63.7091	71.8298	76.0661	81.6403	(219)
Water heating fuel used												847.4090	(219)
Annual totals kWh/year													
Space heating fuel - main system												4187.5771	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												794.4399	(232)
Total delivered energy for all uses												5829.4260	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	4187.5771	13.3320	558.2878	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	593.1863	15.2900	90.6982	(245)
Low-rate cost	254.2227	5.5000	13.9822	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	794.4399	14.3110	113.6923	(250)
Additional standing charges			24.0000	(251)
Total energy cost			800.6605	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9730	(257)
SAP value		86.4271	
SAP rating (Section 12)		86	(258)
SAP band		B	

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	4187.5771	0.5190	2173.3525	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	847.4090	0.5190	439.8053	(264)
Space and water heating			2613.1578	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	794.4399	0.5190	412.3143	(268)
Total kg/year			3025.4721	(272)
CO2 emissions per m2			10.0600	(273)
EI value			88.2700	
EI rating			88	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.33 × (1 + 0.29 × 0.25) / 2.9789 = 4.800, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 2.9789 = 0.1869, stars = 5
Water heating energy efficiency	12.35 / 2.7351 = 4.517, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	166.3600 (1b)	x	2.9300 (2b)	=	487.4348	(1b) - (3b)
First floor	134.2600 (1c)	x	2.4000 (2c)	=	322.2240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	809.6588	(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) =	0.0865	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2865	(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)	=	0.2650	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2782	0.2650	0.2650	0.2451	0.2451	0.2186	0.2252	0.2120	0.2186	0.2319	0.2319	0.2517	(22b)
Effective ac	0.5387	0.5351	0.5351	0.5300	0.5300	0.5239	0.5254	0.5225	0.5239	0.5269	0.5269	0.5317	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3600	0.1100	18.2996	0.0000	0.0000	(28a)
External Wall 1	246.6800	54.5400	192.1400	0.1900	36.5066	60.0000	11528.4000	(29a)
External Wall 2	32.2900	1.9200	30.3700	0.1800	5.4666	190.0000	5770.3000	(29a)
External Roof 1	152.2000		152.2000	0.0900	13.6980	9.0000	1369.8000	(30)
External Roof 2	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
Total net area of external elements Aum(A, m2)			611.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		141.7808			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			53.3000			18.0000	959.4000	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31141.1400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		103.5897	(35)
Thermal bridges (User defined value 0.037 * total exposed area)		22.6325	(36)
Total fabric heat loss	(33) + (36) =	164.4133	(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	143.9347	142.9733	142.9733	141.6191	141.6191	139.9777	140.3705	139.5967	139.9777	140.7750	140.7750	142.0588	(38)
Heat transfer coeff	308.3481	307.3866	307.3866	306.0325	306.0325	304.3910	304.7838	304.0100	304.3910	305.1883	305.1883	306.4721	(39)
Average = Sum(39)m / 12 =												305.8009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0257	1.0225	1.0225	1.0180	1.0180	1.0125	1.0139	1.0113	1.0125	1.0152	1.0152	1.0195	(40)
HLP (average)												1.0172	(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		3.1327 (42)
Average daily hot water use (litres/day)		108.6025 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	119.4627	115.1186	110.7745	106.4304	102.0863	97.7422	97.7422	102.0863	106.4304	110.7745	115.1186	119.4627	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	177.1598	154.9451	159.8894	139.3955	133.7533	115.4189	106.9526	122.7297	124.1954	144.7378	157.9926	171.5698	(45)
Energy content (annual)										Total = Sum(45)m =		1708.7399	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.5740	23.2418	23.9834	20.9093	20.0630	17.3128	16.0429	18.4094	18.6293	21.7107	23.6989	25.7355	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
									Total per year (kWh/year) = Sum(64)m =			2317.7059	(64)
Heat gains from water heating, kWh/month													
	100.2819	88.8914	94.5396	86.3906	85.8493	78.4184	76.9381	82.1839	81.3366	89.5016	92.5742	98.4233	(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	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	112.4612	99.8870	81.2336	61.4991	45.9713	38.8109	41.9365	54.5107	73.1641	92.8987	108.4265	115.5868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7259	691.8312	673.9261	635.8081	587.6910	542.4678	512.2558	505.1505	523.0557	561.1736	609.2907	654.5140	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	(71)
Water heating gains (Table 5)													
	134.7876	132.2789	127.0693	119.9869	115.3888	108.9144	103.4114	110.4623	112.9675	120.2979	128.5752	132.2893	(72)
Total internal gains													
	1051.5586	1043.5810	1001.8128	936.8780	868.6350	809.7769	777.1876	789.7074	828.7712	893.9541	965.8763	1021.9741	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	11.9814	0.7200	0.7000	0.7700	3.6408	(74)
East	12.2400	22.3313	0.7200	0.7000	0.7700	95.4684	(76)
South	3.6600	50.9848	0.7200	0.7000	0.7700	65.1757	(78)
West	20.8200	22.3313	0.7200	0.7000	0.7700	162.3898	(80)

Solar gains	326.6747	555.8489	867.8441	1262.6991	1482.8626	1615.7002	1524.9525	1355.2812	1078.1677	692.8238	413.0750	268.8136	(83)
Total gains	1378.2332	1599.4299	1869.6570	2199.5771	2351.4976	2425.4771	2302.1402	2144.9885	1906.9388	1586.7779	1378.9513	1290.7877	(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	28.0537	28.1415	28.1415	28.2660	28.2660	28.4184	28.3818	28.4541	28.4184	28.3442	28.3442	28.2255	
alpha	2.8702	2.8761	2.8761	2.8844	2.8844	2.8946	2.8921	2.8969	2.8946	2.8896	2.8896	2.8817	
util living area													
	0.9810	0.9703	0.9428	0.8766	0.7573	0.5550	0.3914	0.4272	0.7139	0.9103	0.9687	0.9839	(86)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
Tweekend	19.8939	20.0016	20.2269	20.5060	20.7427	20.8880	20.9270	20.9233	20.8204	20.5189	20.1620	19.8764	
24 / 16	8	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	2	20	7	0	0	0	0	0	0	0	0	22	
MIT	20.8930	20.0016	19.9404	20.2287	20.6029	20.8279	20.8873	20.8817	20.7196	20.2575	19.6916	19.8764	(87)
Th 2	20.0620	20.0646	20.0646	20.0684	20.0684	20.0729	20.0718	20.0739	20.0729	20.0707	20.0707	20.0671	(88)
util rest of house													
	0.9779	0.9655	0.9330	0.8544	0.7108	0.4725	0.2819	0.3140	0.6440	0.8891	0.9626	0.9813	(89)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
Tweekend	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
MIT 2	19.8379	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	(90)
Living area fraction										fLA = Living area / (4) =		0.2814	(91)
MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9553	0.9176	0.8361	0.7005	0.4791	0.2973	0.3295	0.6407	0.8717	0.9508	0.9745	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Useful gains	1348.1725	1527.9258	1715.5930	1839.1529	1647.1819	1162.0467	684.4114	706.7415	1221.8617	1383.2705	1311.0532	1257.8345	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4635.9232	3982.3835	3534.9710	2914.2964	2106.8130	1260.9166	700.1478	728.0826	1471.4866	2398.8463	3275.3098	4051.5072	(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	2446.0865	1649.3955	1353.6173	774.1033	341.9655	0.0000	0.0000	0.0000	0.0000	755.5884	1414.2647	2078.4924	(98)
Space heating												10813.5136	(98)
Space heating per m2											(98) / (4) =	35.9707	(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 %)												298.1246	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3627.1788	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2446.0865	1649.3955	1353.6173	774.1033	341.9655	0.0000	0.0000	0.0000	0.0000	755.5884	1414.2647	2078.4924	(98)
Space heating efficiency (main heating system 1)	298.1246	298.1246	298.1246	298.1246	298.1246	0.0000	0.0000	0.0000	0.0000	298.1246	298.1246	298.1246	(210)
Space heating fuel (main heating system)	820.4912	553.2570	454.0441	259.6576	114.7056	0.0000	0.0000	0.0000	0.0000	253.4471	474.3871	697.1891	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.6841	73.7318	77.3696	69.2666	67.8136	60.5001	58.0147	63.7831	63.7091	71.8298	76.0661	81.6403	(219)
Water heating fuel used												847.4090	(219)
Annual totals kWh/year													
Space heating fuel - main system												3627.1788	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												794.4399	(232)
Total delivered energy for all uses												5269.0277	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	3627.1788	42.0240	1524.2856	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	593.1863	49.5400	293.8645	(245)
Low-rate cost	254.2227	11.9600	30.4050	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	794.4399	45.7820	363.7105	(250)
Additional standing charges			0.0000	(251)
Total energy cost			2212.2656	(255)

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	3627.1788	0.5190	1882.5058	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	847.4090	0.5190	439.8053	(264)
Space and water heating			2322.3110	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	794.4399	0.5190	412.3143	(268)
Total kg/year			2734.6254	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3627.1788	3.0700	11135.4388	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	847.4090	3.0700	2601.5455	(264)
Space and water heating			13736.9844	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	794.4399	3.0700	2438.9306	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/year	16175.9150 (272)
Primary energy kWh/m2/year	53.8085 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 86
Current environmental impact rating:	B 88

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 4.0	-£ 752	-947 kg (34.6%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.6	-£ 114	-160 kg (5.9%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar photovoltaic panels		£752	3.15 kg/m²	B 90	A 92
	Total Savings	£752	3.15 kg/m²		

Potential energy efficiency rating:	B 90
Potential environmental impact rating:	A 92

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£2212	£2212	£0
Space heating	£1524	£1524	£0
Water heating	£324	£324	£0
Lighting	£364	£364	£0
Generated (PV)	-£0	-£752	£752
Total cost of fuels	£2212	£1460	£752
Total cost of uses	£2212	£1460	£752
Delivered energy	18 kWh/m²	11 kWh/m²	6 kWh/m²
Carbon dioxide emissions	2.7 tonnes	1.8 tonnes	0.9 tonnes
CO2 emissions per m²	9 kg/m²	6 kg/m²	3 kg/m²
Primary energy	54 kWh/m²	35 kWh/m²	19 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	166.3600 (1b)	x	2.9300 (2b)	=	487.4348	(1b) - (3b)
First floor	134.2600 (1c)	x	2.4000 (2c)	=	322.2240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	809.6588	(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) =	0.0865	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2865	(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)	=	0.2650	(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	0.3378	0.3312	0.3246	0.2915	0.2848	0.2517	0.2517	0.2451	0.2650	0.2848	0.2981	0.3113	(22b)
Effective ac	0.5571	0.5549	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3600	0.1100	18.2996	0.0000	0.0000	(28a)
External Wall 1	246.6800	54.5400	192.1400	0.1900	36.5066	60.0000	11528.4000	(29a)
External Wall 2	32.2900	1.9200	30.3700	0.1800	5.4666	190.0000	5770.3000	(29a)
External Roof 1	152.2000		152.2000	0.0900	13.6980	9.0000	1369.8000	(30)
External Roof 2	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
Total net area of external elements Aum(A, m2)			611.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		141.7808			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			53.3000			18.0000	959.4000	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31141.1400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		103.5897	(35)
Thermal bridges (User defined value 0.037 * total exposed area)		22.6325	(36)
Total fabric heat loss	(33) + (36) =	164.4133	(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	148.8415	148.2494	147.6690	144.9431	144.4330	142.0588	142.0588	141.6191	142.9733	144.4330	145.4648	146.5435	(38)
Heat transfer coeff	313.2548	312.6627	312.0823	309.3564	308.8464	306.4721	306.4721	306.0325	307.3866	308.8464	309.8781	310.9568	(39)
Average = Sum(39)m / 12 =												309.3539	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0420	1.0401	1.0381	1.0291	1.0274	1.0195	1.0195	1.0180	1.0225	1.0274	1.0308	1.0344	(40)
HLP (average)												1.0291	(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		3.1327 (42)
Average daily hot water use (litres/day)		108.6025 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	119.4627	115.1186	110.7745	106.4304	102.0863	97.7422	97.7422	102.0863	106.4304	110.7745	115.1186	119.4627	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	177.1598	154.9451	159.8894	139.3955	133.7533	115.4189	106.9526	122.7297	124.1954	144.7378	157.9926	171.5698	(45)
Energy content (annual)										Total = Sum(45)m =		1708.7399	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.5740	23.2418	23.9834	20.9093	20.0630	17.3128	16.0429	18.4094	18.6293	21.7107	23.6989	25.7355	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
									Total per year (kWh/year) = Sum(64)m =			2317.7059	(64)
Heat gains from water heating, kWh/month													
	100.2819	88.8914	94.5396	86.3906	85.8493	78.4184	76.9381	82.1839	81.3366	89.5016	92.5742	98.4233	(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	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	112.4612	99.8870	81.2336	61.4991	45.9713	38.8109	41.9365	54.5107	73.1641	92.8987	108.4265	115.5868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7259	691.8312	673.9261	635.8081	587.6910	542.4678	512.2558	505.1505	523.0557	561.1736	609.2907	654.5140	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	(71)
Water heating gains (Table 5)													
	134.7876	132.2789	127.0693	119.9869	115.3888	108.9144	103.4114	110.4623	112.9675	120.2979	128.5752	132.2893	(72)
Total internal gains													
	1051.5586	1043.5810	1001.8128	936.8780	868.6350	809.7769	777.1876	789.7074	828.7712	893.9541	965.8763	1021.9741	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1341.3393	1591.2744	1867.5969	2160.2002	2344.0562	2312.1932	2210.6374	2035.0163	1821.3609	1533.2918	1323.4780	1262.8068	(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	27.6143	27.6666	27.7181	27.9623	28.0085	28.2255	28.2255	28.2660	28.1415	28.0085	27.9152	27.8184	
alpha	2.8410	2.8444	2.8479	2.8642	2.8672	2.8817	2.8817	2.8844	2.8761	2.8672	2.8610	2.8546	
util living area													
	0.9844	0.9738	0.9511	0.9005	0.8113	0.6786	0.5429	0.5950	0.7955	0.9335	0.9761	0.9868	(86)
Tweekday	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
Tweekend	19.7938	19.9181	20.1331	20.4106	20.6538	20.8239	20.8959	20.8816	20.7415	20.4154	20.0529	19.7714	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	22	0	0	0	0	0	0	0	0	0	0	1	
16 / 9	0	20	7	0	0	0	0	0	0	0	0	21	
MIT	21.0000	19.9181	19.8120	20.0796	20.4657	20.7295	20.8394	20.8173	20.5963	20.0977	19.5212	19.8110	(87)
Th 2	20.0485	20.0501	20.0517	20.0592	20.0606	20.0671	20.0671	20.0684	20.0646	20.0606	20.0577	20.0548	(88)
util rest of house													
	0.9819	0.9697	0.9431	0.8832	0.7761	0.6141	0.4486	0.5023	0.7445	0.9184	0.9716	0.9847	(89)
Tweekday	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
Tweekend	17.5112	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.4649	
MIT 2	20.0485	17.7918	18.2742	18.8927	19.4147	19.7596	19.8831	19.8646	19.6088	18.9141	18.1025	17.5484	(90)
Living area fraction										fLA = Living area / (4) =		0.2814	(91)
MIT	20.3162	18.3900	18.7069	19.2266	19.7104	20.0325	20.1521	20.1327	19.8866	19.2471	18.5016	18.1850	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3162	18.3900	18.7069	19.2266	19.7104	20.0325	20.1521	20.1327	19.8866	19.2471	18.5016	18.1850	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9601	0.9285	0.8646	0.7611	0.6115	0.4578	0.5092	0.7332	0.9018	0.9615	0.9790	(94)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	1318.0291	1527.8541	1733.9760	1867.6103	1783.9793	1413.8482	1011.9761	1036.3198	1335.3482	1382.6479	1272.4583	1236.3156	(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	5017.1434	4217.8259	3809.5474	3194.6083	2473.9743	1664.9142	1088.6319	1142.3186	1778.7386	2670.6239	3533.1208	4348.7254	(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	2752.1410	1807.6611	1544.2251	955.4386	513.3563	0.0000	0.0000	0.0000	0.0000	958.2541	1627.6770	2315.6329	(98)
Space heating												12474.3861	(98)
Space heating per m2											(98) / (4) =	41.4955	(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 %)												297.8903	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4187.5771	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2752.1410	1807.6611	1544.2251	955.4386	513.3563	0.0000	0.0000	0.0000	0.0000	958.2541	1627.6770	2315.6329	(98)
Space heating efficiency (main heating system 1)	297.8903	297.8903	297.8903	297.8903	297.8903	0.0000	0.0000	0.0000	0.0000	297.8903	297.8903	297.8903	(210)
Space heating fuel (main heating system)	923.8774	606.8211	518.3872	320.7350	172.3306	0.0000	0.0000	0.0000	0.0000	321.6802	546.4015	777.3442	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.6841	73.7318	77.3696	69.2666	67.8136	60.5001	58.0147	63.7831	63.7091	71.8298	76.0661	81.6403	(219)
Water heating fuel used												847.4090	(219)
Annual totals kWh/year													
Space heating fuel - main system												4187.5771	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												794.4399	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4102.1866	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	4187.5771	13.3320	558.2878	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	593.1863	15.2900	90.6982	(245)
Low-rate cost	254.2227	5.5000	13.9822	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	794.4399	14.3110	113.6923	(250)
Additional standing charges			24.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	13.7505	-237.5041	(252)
Total energy cost			563.1565	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6844	(257)
SAP value		90.4533	
SAP rating (Section 12)		90	(258)
SAP band		B	

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	4187.5771	0.5190	2173.3525	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	847.4090	0.5190	439.8053	(264)
Space and water heating			2613.1578	(265)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	794.4399	0.5190	412.3143 (268)
Energy saving/generation technologies			
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			2129.0349 (272)
CO2 emissions per m2			7.0800 (273)
EI value			91.7455
EI rating			92 (274)
EI band			A

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	166.3600	(1b)	x 2.9300	(2b) =	487.4348	(1b) - (3b)
First floor	134.2600	(1c)	x 2.4000	(2c) =	322.2240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		809.6588	(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) =	0.0865	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2865	(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) =		0.2650	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2782	0.2650	0.2650	0.2451	0.2451	0.2186	0.2252	0.2120	0.2186	0.2319	0.2319	0.2517	(22b)
Effective ac	0.5387	0.5351	0.5351	0.5300	0.5300	0.5239	0.5254	0.5225	0.5239	0.5269	0.5269	0.5317	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3600	0.1100	18.2996	0.0000	0.0000	(28a)
External Wall 1	246.6800	54.5400	192.1400	0.1900	36.5066	60.0000	11528.4000	(29a)
External Wall 2	32.2900	1.9200	30.3700	0.1800	5.4666	190.0000	5770.3000	(29a)
External Roof 1	152.2000		152.2000	0.0900	13.6980	9.0000	1369.8000	(30)
External Roof 2	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
Total net area of external elements Aum(A, m2)			611.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		141.7808			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			53.3000			18.0000	959.4000	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31141.1400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		103.5897 (35)
Thermal bridges (User defined value 0.037 * total exposed area)		22.6325 (36)
Total fabric heat loss	(33) + (36) =	164.4133 (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	143.9347	142.9733	142.9733	141.6191	141.6191	139.9777	140.3705	139.5967	139.9777	140.7750	140.7750	142.0588	(38)
Heat transfer coeff	308.3481	307.3866	307.3866	306.0325	306.0325	304.3910	304.7838	304.0100	304.3910	305.1883	305.1883	306.4721	(39)
Average = Sum(39)m / 12 =												305.8009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0257	1.0225	1.0225	1.0180	1.0180	1.0125	1.0139	1.0113	1.0125	1.0152	1.0152	1.0195	(40)
HLP (average)												1.0172	(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		3.1327 (42)
Average daily hot water use (litres/day)		108.6025 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	119.4627	115.1186	110.7745	106.4304	102.0863	97.7422	97.7422	102.0863	106.4304	110.7745	115.1186	119.4627	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	177.1598	154.9451	159.8894	139.3955	133.7533	115.4189	106.9526	122.7297	124.1954	144.7378	157.9926	171.5698	(45)
Energy content (annual)										Total = Sum(45)m =		1708.7399	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.5740	23.2418	23.9834	20.9093	20.0630	17.3128	16.0429	18.4094	18.6293	21.7107	23.6989	25.7355	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(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													
	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
									Total per year (kWh/year) = Sum(64)m =			2317.7059	(64)
Heat gains from water heating, kWh/month													
	100.2819	88.8914	94.5396	86.3906	85.8493	78.4184	76.9381	82.1839	81.3366	89.5016	92.5742	98.4233	(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	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	187.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	112.4612	99.8870	81.2336	61.4991	45.9713	38.8109	41.9365	54.5107	73.1641	92.8987	108.4265	115.5868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7259	691.8312	673.9261	635.8081	587.6910	542.4678	512.2558	505.1505	523.0557	561.1736	609.2907	654.5140	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	-125.3094	(71)
Water heating gains (Table 5)													
	134.7876	132.2789	127.0693	119.9869	115.3888	108.9144	103.4114	110.4623	112.9675	120.2979	128.5752	132.2893	(72)
Total internal gains													
	1051.5586	1043.5810	1001.8128	936.8780	868.6350	809.7769	777.1876	789.7074	828.7712	893.9541	965.8763	1021.9741	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	11.9814	0.7200	0.7000	0.7700	3.6408	(74)
East	12.2400	22.3313	0.7200	0.7000	0.7700	95.4684	(76)
South	3.6600	50.9848	0.7200	0.7000	0.7700	65.1757	(78)
West	20.8200	22.3313	0.7200	0.7000	0.7700	162.3898	(80)

Solar gains	326.6747	555.8489	867.8441	1262.6991	1482.8626	1615.7002	1524.9525	1355.2812	1078.1677	692.8238	413.0750	268.8136	(83)
Total gains	1378.2332	1599.4299	1869.6570	2199.5771	2351.4976	2425.4771	2302.1402	2144.9885	1906.9388	1586.7779	1378.9513	1290.7877	(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	28.0537	28.1415	28.1415	28.2660	28.2660	28.4184	28.3818	28.4541	28.4184	28.3442	28.3442	28.2255	
alpha	2.8702	2.8761	2.8761	2.8844	2.8844	2.8946	2.8921	2.8969	2.8946	2.8896	2.8896	2.8817	
util living area													
	0.9810	0.9703	0.9428	0.8766	0.7573	0.5550	0.3914	0.4272	0.7139	0.9103	0.9687	0.9839	(86)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
Tweekend	19.8939	20.0016	20.2269	20.5060	20.7427	20.8880	20.9270	20.9233	20.8204	20.5189	20.1620	19.8764	
24 / 16	8	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	2	20	7	0	0	0	0	0	0	0	0	22	
MIT	20.8930	20.0016	19.9404	20.2287	20.6029	20.8279	20.8873	20.8817	20.7196	20.2575	19.6916	19.8764	(87)
Th 2	20.0620	20.0646	20.0646	20.0684	20.0684	20.0729	20.0718	20.0739	20.0729	20.0707	20.0707	20.0671	(88)
util rest of house													
	0.9779	0.9655	0.9330	0.8544	0.7108	0.4725	0.2819	0.3140	0.6440	0.8891	0.9626	0.9813	(89)
Tweekday	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
Tweekend	17.7461	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	
MIT 2	19.8379	17.9895	18.4928	19.1073	19.6029	19.8740	19.9270	19.9261	19.7659	19.1481	18.3565	17.7104	(90)
Living area fraction										fLA = Living area / (4) =		0.2814	(91)
MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1347	18.5556	18.9001	19.4228	19.8843	20.1424	20.1972	20.1949	20.0342	19.4602	18.7321	18.3198	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9553	0.9176	0.8361	0.7005	0.4791	0.2973	0.3295	0.6407	0.8717	0.9508	0.9745	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	1348.1725	1527.9258	1715.5930	1839.1529	1647.1819	1162.0467	684.4114	706.7415	1221.8617	1383.2705	1311.0532	1257.8345	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4635.9232	3982.3835	3534.9710	2914.2964	2106.8130	1260.9166	700.1478	728.0826	1471.4866	2398.8463	3275.3098	4051.5072	(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	2446.0865	1649.3955	1353.6173	774.1033	341.9655	0.0000	0.0000	0.0000	0.0000	755.5884	1414.2647	2078.4924	(98)
Space heating												10813.5136	(98)
Space heating per m2											(98) / (4) =	35.9707	(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 %)												298.1246	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3627.1788	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2446.0865	1649.3955	1353.6173	774.1033	341.9655	0.0000	0.0000	0.0000	0.0000	755.5884	1414.2647	2078.4924	(98)
Space heating efficiency (main heating system 1)	298.1246	298.1246	298.1246	298.1246	298.1246	0.0000	0.0000	0.0000	0.0000	298.1246	298.1246	298.1246	(210)
Space heating fuel (main heating system)	820.4912	553.2570	454.0441	259.6576	114.7056	0.0000	0.0000	0.0000	0.0000	253.4471	474.3871	697.1891	(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	228.8802	201.6603	211.6098	189.4475	185.4737	165.4709	158.6730	174.4501	174.2474	196.4582	208.0446	223.2902	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.6841	73.7318	77.3696	69.2666	67.8136	60.5001	58.0147	63.7831	63.7091	71.8298	76.0661	81.6403	(219)
Water heating fuel used												847.4090	(219)
Annual totals kWh/year													
Space heating fuel - main system												3627.1788	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												794.4399	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												3444.8680	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	3627.1788	42.0240	1524.2856	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	593.1863	49.5400	293.8645	(245)
Low-rate cost	254.2227	11.9600	30.4050	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	794.4399	45.7820	363.7105	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	41.2510	-752.4841	(252)
Total energy cost			1459.7815	(255)

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	3627.1788	0.5190	1882.5058	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	847.4090	0.5190	439.8053	(264)
Space and water heating			2322.3110	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	794.4399	0.5190	412.3143	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			1787.8865	(272)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3627.1788	3.0700	11135.4388	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	847.4090	3.0700	2601.5455	(264)
Space and water heating			13736.9844	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	794.4399	3.0700	2438.9306	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			10575.7449	(272)
Primary energy kWh/m2/year			35.1798	(273)

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

Property Reference	P2 Oak	**Issued on Date**	16/01/2024
Assessment Reference	P2 Oak	**Prop Type Ref**	End
Property	1, Oakley		

SAP Rating	87 B	**DER**	10.38	**TER**	21.28
Environmental	89 B	**% DER<TER**	51.23		
CO_2 Emissions (t/year)	2.35	**DFEE**	44.61	**TFEE**	57.66
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.63		

Assessor Details	Mrs. Naomi Sadler, Sadler Energy & Environmental Services Ltd, Tel: 01962 718870, naomi.sadler@sadlerenergy.co.uk	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne		

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.9300	(2b) =	396.3704	(1b) - (3b)
First floor	135.2800	(1c)	x 2.4000	(2c) =	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		721.0424	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0832	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2832	(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) =	0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	39.4100	172.8600	0.1900	32.8434	60.0000	10371.6000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.0159			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38209.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.2250 (35)
Thermal bridges (User defined value 0.033 * total exposed area)		18.5882 (36)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 147.6042 (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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.5780	274.7411	274.7411	273.5623	273.5623	272.1335	272.4754	271.8017	272.1335	272.8275	272.8275	273.9451	(39)
Average = Sum(39)m / 12 =												273.3607	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0185	1.0155	1.0155	1.0111	1.0111	1.0058	1.0071	1.0046	1.0058	1.0084	1.0084	1.0125	(40)
HLP (average)												1.0104	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)

Average daily hot water use (litres/day) 107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)
Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
										Total per year (kWh/year) = Sum(64)m =		2303.1032	(64)
RHI water heating demand												2303	(64)
Heat gains from water heating, kWh/month	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.4938	89.2577	72.5892	54.9547	41.0793	34.6809	37.4739	48.7100	65.3785	83.0130	96.8884	103.2868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains	1000.8402	993.8380	955.0674	894.3539	830.4040	774.8082	743.5666	755.0722	791.1616	852.1210	919.7187	972.5778	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	11.9814	0.7200	0.7000	0.7700	29.1261	(74)
East	15.6500	22.3313	0.7200	0.7000	0.7700	122.0654	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	319.6650	561.7771	915.8645	1386.6530	1669.2059	1836.3868	1726.1676	1505.4580	1157.3892	711.8749	408.0325	260.5938	(83)
Total gains	1320.5052	1555.6151	1870.9319	2281.0069	2499.6099	2611.1950	2469.7342	2260.5302	1948.5508	1563.9959	1327.7512	1233.1716	(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	38.5148	38.6322	38.6322	38.7986	38.7986	39.0023	38.9534	39.0499	39.0023	38.9031	38.9031	38.7444
alpha	3.5677	3.5755	3.5755	3.5866	3.5866	3.6002	3.5969	3.6033	3.6002	3.5935	3.5935	3.5830
util living area												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	0.9903	0.9821	0.9560	0.8780	0.7273	0.4960	0.3372	0.3771	0.6939	0.9264	0.9815	0.9922	(86)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	20.1326	20.2308	20.4321	20.6755	20.8525	20.9340	20.9483	20.9469	20.8910	20.6535	20.3523	20.1159	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6083	19.9364	20.1236	20.4933	20.7723	20.8986	20.9202	20.9181	20.8299	20.4652	19.9886	20.1159	(87)
Th 2	20.0679	20.0705	20.0705	20.0741	20.0741	20.0785	20.0774	20.0795	20.0785	20.0764	20.0764	20.0729	(88)
util rest of house													
	0.9883	0.9785	0.9467	0.8523	0.6731	0.4136	0.2391	0.2722	0.6155	0.9048	0.9769	0.9905	(89)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
MIT 2	19.2496	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9868	0.9716	0.9352	0.8393	0.6690	0.4199	0.2484	0.2820	0.6161	0.8920	0.9696	0.9869	(94)
Useful gains	1303.1201	1511.4251	1749.6746	1914.5041	1672.3109	1096.4629	613.4863	637.4967	1200.5583	1395.1382	1287.4133	1217.0511	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	3976.7018	3621.0218	3234.9709	2672.9287	1917.6058	1128.3876	616.6374	642.4537	1329.3770	2193.1670	3004.3874	3701.9281	(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													
	1989.1448	1417.6490	1105.0605	546.0657	182.4994	0.0000	0.0000	0.0000	0.0000	593.7334	1236.2214	1848.7485	(98)
Space heating												8919.1226	(98)
RHI space heating demand												8919	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.9300	(2b) =	396.3704	(1b) - (3b)
First floor	135.2800	(1c)	x 2.4000	(2c) =	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		721.0424	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0832	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2832	(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) =	0.2620	(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	0.3340	0.3275	0.3209	0.2882	0.2816	0.2489	0.2489	0.2423	0.2620	0.2816	0.2947	0.3078	(22b)
Effective ac	0.5558	0.5536	0.5515	0.5415	0.5397	0.5310	0.5310	0.5294	0.5343	0.5397	0.5434	0.5474	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	39.4100	172.8600	0.1900	32.8434	60.0000	10371.6000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	129.0159			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38209.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.2250 (35)
Thermal bridges (User defined value 0.033 * total exposed area)		18.5882 (36)
Total fabric heat loss	(33) + (36) =	147.6042 (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	132.2452	131.7297	131.2245	128.8516	128.4076	126.3409	126.3409	125.9581	127.1370	128.4076	129.3058	130.2447	(38)
Heat transfer coeff	279.8493	279.3339	278.8287	276.4558	276.0118	273.9451	273.9451	273.5623	274.7411	276.0118	276.9100	277.8489	(39)
Average = Sum(39)m / 12 =												276.4537	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0343	1.0324	1.0306	1.0218	1.0202	1.0125	1.0125	1.0111	1.0155	1.0202	1.0235	1.0269	(40)
HLP (average)												1.0218	(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	3.0937 (42)
Average daily hot water use (litres/day)	107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.4938	89.2577	72.5892	54.9547	41.0793	34.6809	37.4739	48.7100	65.3785	83.0130	96.8884	103.2868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1000.8402	993.8380	955.0674	894.3539	830.4040	774.8082	743.5666	755.0722	791.1616	852.1210	919.7187	972.5778	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1282.2166	1543.1026	1862.2157	2229.7834	2483.4122	2475.4659	2359.0819	2130.8650	1849.5101	1504.0567	1270.2194	1204.2601	(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	37.9270	37.9970	38.0658	38.3925	38.4543	38.7444	38.7444	38.7986	38.6322	38.4543	38.3296	38.2000	
alpha	3.5285	3.5331	3.5377	3.5595	3.5636	3.5830	3.5830	3.5866	3.5755	3.5636	3.5553	3.5467	
util living area													
	0.9924	0.9849	0.9642	0.9066	0.7936	0.6327	0.4873	0.5504	0.7910	0.9498	0.9869	0.9939	(86)
Tweekday	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
Tweekend	20.0491	20.1610	20.3543	20.5989	20.7924	20.9014	20.9364	20.9285	20.8359	20.5673	20.2608	20.0289	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	13	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	9	7	0	0	0	0	0	0	0	0	0	22	
MIT	20.6012	19.8628	20.0035	20.3737	20.6796	20.8485	20.9019	20.8897	20.7437	20.3322	19.8458	20.0289	(87)
Th 2	20.0548	20.0564	20.0579	20.0652	20.0666	20.0729	20.0729	20.0741	20.0705	20.0666	20.0638	20.0609	(88)
util rest of house													
	0.9909	0.9818	0.9568	0.8871	0.7517	0.5616	0.3938	0.4543	0.7324	0.9355	0.9838	0.9927	(89)
Tweekday	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
Tweekend	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
MIT 2	19.2175	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.5034	18.6317	19.0049	19.5108	19.8935	20.0934	20.1460	20.1374	19.9849	19.4566	18.8122	18.4326	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5034	18.6317	19.0049	19.5108	19.8935	20.0934	20.1460	20.1374	19.9849	19.4566	18.8122	18.4326	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9898	0.9757	0.9462	0.8734	0.7430	0.5633	0.4015	0.4612	0.7262	0.9235	0.9780	0.9897	(94)
Useful gains	1269.1512	1505.5406	1762.0571	1947.4379	1845.0990	1394.4206	947.2068	982.8607	1343.0921	1389.0155	1242.2431	1191.8565	(95)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	4254.6732	3835.7357	3486.7179	2933.4139	2261.5047	1504.8841	971.4051	1022.4105	1616.8337	2444.5326	3243.2141	3954.5196	(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	2221.2283	1565.8911	1283.1476	709.9027	309.8058	0.0000	0.0000	0.0000	0.0000	785.3047	1440.6992	2055.4214	(98)
Space heating												10371.4009	(98)
Space heating per m2											(98) / (4) =	38.3331	(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 %)												300.3082	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3453.5861	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2221.2283	1565.8911	1283.1476	709.9027	309.8058	0.0000	0.0000	0.0000	0.0000	785.3047	1440.6992	2055.4214	(98)
Space heating efficiency (main heating system 1)	300.3082	300.3082	300.3082	300.3082	300.3082	0.0000	0.0000	0.0000	0.0000	300.3082	300.3082	300.3082	(210)
Space heating fuel (main heating system)	739.6497	521.4281	427.2770	236.3914	103.1626	0.0000	0.0000	0.0000	0.0000	261.4996	479.7403	684.4374	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												3453.5861	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												709.9008	(232)
Total delivered energy for all uses												5005.5568	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	3453.5861	13.3320	460.4321	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	15.2900	90.1267	(245)
Low-rate cost	252.6210	5.5000	13.8942	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	709.9008	14.3110	101.5939	(250)
Additional standing charges			24.0000	(251)
Total energy cost			690.0469	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9184	(257)
SAP value		87.1879	
SAP rating (Section 12)		87	(258)
SAP band		B	

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	3453.5861	0.5190	1792.4112	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			2229.4455	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	709.9008	0.5190	368.4385	(268)
Total kg/year			2597.8840	(272)
CO2 emissions per m2			9.6000	(273)
EI value			88.9683	
EI rating			89	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	13.33 × (1 + 0.29 × 0.25) / 3.0031 = 4.761, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 3.0031 = 0.1854, stars = 5
Water heating energy efficiency	12.35 / 2.7351 = 4.517, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10	=	60.0000	(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) =	60.0000	/ (5) =	0.0832	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2832	(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)	=	0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	39.4100	172.8600	0.1900	32.8434	60.0000	10371.6000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	129.0159			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38209.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.2250	(35)
Thermal bridges (User defined value 0.033 * total exposed area)		18.5882	(36)
Total fabric heat loss	(33) + (36) =	147.6042	(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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.5780	274.7411	274.7411	273.5623	273.5623	272.1335	272.4754	271.8017	272.1335	272.8275	272.8275	273.9451	(39)
Average = Sum(39)m / 12 =												273.3607	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0185	1.0155	1.0155	1.0111	1.0111	1.0058	1.0071	1.0046	1.0058	1.0084	1.0084	1.0125	(40)
HLP (average)												1.0104	(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		3.0937 (42)
Average daily hot water use (litres/day)		107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.4938	89.2577	72.5892	54.9547	41.0793	34.6809	37.4739	48.7100	65.3785	83.0130	96.8884	103.2868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1000.8402	993.8380	955.0674	894.3539	830.4040	774.8082	743.5666	755.0722	791.1616	852.1210	919.7187	972.5778	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	11.9814	0.7200	0.7000	0.7700	29.1261	(74)
East	15.6500	22.3313	0.7200	0.7000	0.7700	122.0654	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	319.6650	561.7771	915.8645	1386.6530	1669.2059	1836.3868	1726.1676	1505.4580	1157.3892	711.8749	408.0325	260.5938	(83)
Total gains	1320.5052	1555.6151	1870.9319	2281.0069	2499.6099	2611.1950	2469.7342	2260.5302	1948.5508	1563.9959	1327.7512	1233.1716	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.5148	38.6322	38.6322	38.7986	38.7986	39.0023	38.9534	39.0499	39.0023	38.9031	38.9031	38.7444	
alpha	3.5677	3.5755	3.5755	3.5866	3.5866	3.6002	3.5969	3.6033	3.6002	3.5935	3.5935	3.5830	
util living area													
	0.9903	0.9821	0.9560	0.8780	0.7273	0.4960	0.3372	0.3771	0.6939	0.9264	0.9815	0.9922	(86)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	20.1326	20.2308	20.4321	20.6755	20.8525	20.9340	20.9483	20.9469	20.8910	20.6535	20.3523	20.1159	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6083	19.9364	20.1236	20.4933	20.7723	20.8986	20.9202	20.9181	20.8299	20.4652	19.9886	20.1159	(87)
Th 2	20.0679	20.0705	20.0705	20.0741	20.0741	20.0785	20.0774	20.0795	20.0785	20.0764	20.0764	20.0729	(88)
util rest of house													
	0.9883	0.9785	0.9467	0.8523	0.6731	0.4136	0.2391	0.2722	0.6155	0.9048	0.9769	0.9905	(89)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
MIT 2	19.2496	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9868	0.9716	0.9352	0.8393	0.6690	0.4199	0.2484	0.2820	0.6161	0.8920	0.9696	0.9869	(94)
Useful gains	1303.1201	1511.4251	1749.6746	1914.5041	1672.3109	1096.4629	613.4863	637.4967	1200.5583	1395.1382	1287.4133	1217.0511	(95)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	3976.7018	3621.0218	3234.9709	2672.9287	1917.6058	1128.3876	616.6374	642.4537	1329.3770	2193.1670	3004.3874	3701.9281 (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	1989.1448	1417.6490	1105.0605	546.0657	182.4994	0.0000	0.0000	0.0000	0.0000	593.7334	1236.2214	1848.7485 (98)
Space heating												8919.1226 (98)
Space heating per m2											(98) / (4) =	32.9654 (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 %)												300.5677	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2967.4255	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1989.1448	1417.6490	1105.0605	546.0657	182.4994	0.0000	0.0000	0.0000	0.0000	593.7334	1236.2214	1848.7485	(98)
Space heating efficiency (main heating system 1)	300.5677	300.5677	300.5677	300.5677	300.5677	0.0000	0.0000	0.0000	0.0000	300.5677	300.5677	300.5677	(210)
Space heating fuel (main heating system)	661.7959	471.6571	367.6578	181.6781	60.7182	0.0000	0.0000	0.0000	0.0000	197.5373	411.2955	615.0855	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												2967.4255	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												709.9008	(232)
Total delivered energy for all uses												4519.3962	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	2967.4255	42.0240	1247.0309	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	49.5400	292.0130	(245)
Low-rate cost	252.6210	11.9600	30.2135	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	709.9008	45.7820	325.0068	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1894.2641	(255)

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	2967.4255	0.5190	1540.0938	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			1977.1281	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	709.9008	0.5190	368.4385	(268)
Total kg/year			2345.5666	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2967.4255	3.0700	9109.9964	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	842.0699	3.0700	2585.1545	(264)
Space and water heating			11695.1509	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	709.9008	3.0700	2179.3954	(268)
Primary energy kWh/year			13874.5463	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 51.2808 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 4.4	-£ 752	-947 kg (40.4%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 114	-160 kg (6.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£752	3.50 kg/m²	A 92	A 93
Total Savings	£752	3.50 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1894	£1894	£0
Space heating	£1247	£1247	£0
Water heating	£322	£322	£0
Lighting	£325	£325	£0
Generated (PV)	-£0	-£752	£752
Total cost of fuels	£1894	£1142	£752
Total cost of uses	£1894	£1142	£752
Delivered energy	17 kWh/m²	10 kWh/m²	7 kWh/m²
Carbon dioxide emissions	2.3 tonnes	1.4 tonnes	0.9 tonnes
CO2 emissions per m²	9 kg/m²	5 kg/m²	3 kg/m²
Primary energy	51 kWh/m²	31 kWh/m²	21 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0832	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2832	(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) =	0.2620	(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	0.3340	0.3275	0.3209	0.2882	0.2816	0.2489	0.2489	0.2423	0.2620	0.2816	0.2947	0.3078	(22b)
Effective ac	0.5558	0.5536	0.5515	0.5415	0.5397	0.5310	0.5310	0.5294	0.5343	0.5397	0.5434	0.5474	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	39.4100	172.8600	0.1900	32.8434	60.0000	10371.6000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	129.0159			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38209.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.2250 (35)
Thermal bridges (User defined value 0.033 * total exposed area)		18.5882 (36)
Total fabric heat loss	(33) + (36) =	147.6042 (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	132.2452	131.7297	131.2245	128.8516	128.4076	126.3409	126.3409	125.9581	127.1370	128.4076	129.3058	130.2447	(38)
Heat transfer coeff	279.8493	279.3339	278.8287	276.4558	276.0118	273.9451	273.9451	273.5623	274.7411	276.0118	276.9100	277.8489	(39)
Average = Sum(39)m / 12 =												276.4537	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0343	1.0324	1.0306	1.0218	1.0202	1.0125	1.0125	1.0111	1.0155	1.0202	1.0235	1.0269	(40)
HLP (average)												1.0218	(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		3.0937 (42)
Average daily hot water use (litres/day)		107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
								Total per year (kWh/year) = Sum(64)m =				2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.4938	89.2577	72.5892	54.9547	41.0793	34.6809	37.4739	48.7100	65.3785	83.0130	96.8884	103.2868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1000.8402	993.8380	955.0674	894.3539	830.4040	774.8082	743.5666	755.0722	791.1616	852.1210	919.7187	972.5778	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1282.2166	1543.1026	1862.2157	2229.7834	2483.4122	2475.4659	2359.0819	2130.8650	1849.5101	1504.0567	1270.2194	1204.2601	(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	37.9270	37.9970	38.0658	38.3925	38.4543	38.7444	38.7444	38.7986	38.6322	38.4543	38.3296	38.2000	
alpha	3.5285	3.5331	3.5377	3.5595	3.5636	3.5830	3.5830	3.5866	3.5755	3.5636	3.5553	3.5467	
util living area													
	0.9924	0.9849	0.9642	0.9066	0.7936	0.6327	0.4873	0.5504	0.7910	0.9498	0.9869	0.9939	(86)
Tweekday	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
Tweekend	20.0491	20.1610	20.3543	20.5989	20.7924	20.9014	20.9364	20.9285	20.8359	20.5673	20.2608	20.0289	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	13	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	9	7	0	0	0	0	0	0	0	0	0	22	
MIT	20.6012	19.8628	20.0035	20.3737	20.6796	20.8485	20.9019	20.8897	20.7437	20.3322	19.8458	20.0289	(87)
Th 2	20.0548	20.0564	20.0579	20.0652	20.0666	20.0729	20.0729	20.0741	20.0705	20.0666	20.0638	20.0609	(88)
util rest of house													
	0.9909	0.9818	0.9568	0.8871	0.7517	0.5616	0.3938	0.4543	0.7324	0.9355	0.9838	0.9927	(89)
Tweekday	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
Tweekend	18.0581	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	
MIT 2	19.2175	18.3111	18.7448	19.2860	19.6888	19.8967	19.9491	19.9415	19.7873	19.2286	18.5429	18.0169	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.5034	18.6317	19.0049	19.5108	19.8935	20.0934	20.1460	20.1374	19.9849	19.4566	18.8122	18.4326	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5034	18.6317	19.0049	19.5108	19.8935	20.0934	20.1460	20.1374	19.9849	19.4566	18.8122	18.4326	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9898	0.9757	0.9462	0.8734	0.7430	0.5633	0.4015	0.4612	0.7262	0.9235	0.9780	0.9897	(94)
Useful gains	1269.1512	1505.5406	1762.0571	1947.4379	1845.0990	1394.4206	947.2068	982.8607	1343.0921	1389.0155	1242.2431	1191.8565	(95)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	4254.6732	3835.7357	3486.7179	2933.4139	2261.5047	1504.8841	971.4051	1022.4105	1616.8337	2444.5326	3243.2141	3954.5196	(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	2221.2283	1565.8911	1283.1476	709.9027	309.8058	0.0000	0.0000	0.0000	0.0000	785.3047	1440.6992	2055.4214	(98)
Space heating												10371.4009	(98)
Space heating per m2											(98) / (4) =	38.3331	(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 %)												300.3082	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3453.5861	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2221.2283	1565.8911	1283.1476	709.9027	309.8058	0.0000	0.0000	0.0000	0.0000	785.3047	1440.6992	2055.4214	(98)
Space heating efficiency (main heating system 1)	300.3082	300.3082	300.3082	300.3082	300.3082	0.0000	0.0000	0.0000	0.0000	300.3082	300.3082	300.3082	(210)
Space heating fuel (main heating system)	739.6497	521.4281	427.2770	236.3914	103.1626	0.0000	0.0000	0.0000	0.0000	261.4996	479.7403	684.4374	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												3453.5861	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												709.9008	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3278.3174	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	3453.5861	13.3320	460.4321	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	15.2900	90.1267	(245)
Low-rate cost	252.6210	5.5000	13.8942	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	709.9008	14.3110	101.5939	(250)
Additional standing charges			24.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	13.7505	-237.5041	(252)
Total energy cost			452.5428	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6023	(257)
SAP value		91.5976	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	3453.5861	0.5190	1792.4112	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			2229.4455	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	709.9008	0.5190	368.4385 (268)
Energy saving/generation technologies			
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			1701.4467 (272)
CO2 emissions per m2			6.2900 (273)
EI value			92.7749
EI rating			93 (274)
EI band			A

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10	=	60.0000	(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) =	60.0000	/ (5) =	0.0832	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2832	(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)	=	0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	39.4100	172.8600	0.1900	32.8434	60.0000	10371.6000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	129.0159			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38209.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.2250	(35)
Thermal bridges (User defined value 0.033 * total exposed area)		18.5882	(36)
Total fabric heat loss	(33) + (36) =	147.6042	(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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.5780	274.7411	274.7411	273.5623	273.5623	272.1335	272.4754	271.8017	272.1335	272.8275	272.8275	273.9451	(39)
Average = Sum(39)m / 12 =												273.3607	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0185	1.0155	1.0155	1.0111	1.0111	1.0058	1.0071	1.0046	1.0058	1.0084	1.0084	1.0125	(40)
HLP (average)												1.0104	(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	3.0937	(42)
Average daily hot water use (litres/day)	107.6744	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.4938	89.2577	72.5892	54.9547	41.0793	34.6809	37.4739	48.7100	65.3785	83.0130	96.8884	103.2868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1000.8402	993.8380	955.0674	894.3539	830.4040	774.8082	743.5666	755.0722	791.1616	852.1210	919.7187	972.5778	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	11.9814	0.7200	0.7000	0.7700	29.1261	(74)
East	15.6500	22.3313	0.7200	0.7000	0.7700	122.0654	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	319.6650	561.7771	915.8645	1386.6530	1669.2059	1836.3868	1726.1676	1505.4580	1157.3892	711.8749	408.0325	260.5938	(83)
Total gains	1320.5052	1555.6151	1870.9319	2281.0069	2499.6099	2611.1950	2469.7342	2260.5302	1948.5508	1563.9959	1327.7512	1233.1716	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.5148	38.6322	38.6322	38.7986	38.7986	39.0023	38.9534	39.0499	39.0023	38.9031	38.9031	38.7444	
alpha	3.5677	3.5755	3.5755	3.5866	3.5866	3.6002	3.5969	3.6033	3.6002	3.5935	3.5935	3.5830	
util living area													
	0.9903	0.9821	0.9560	0.8780	0.7273	0.4960	0.3372	0.3771	0.6939	0.9264	0.9815	0.9922	(86)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	20.1326	20.2308	20.4321	20.6755	20.8525	20.9340	20.9483	20.9469	20.8910	20.6535	20.3523	20.1159	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6083	19.9364	20.1236	20.4933	20.7723	20.8986	20.9202	20.9181	20.8299	20.4652	19.9886	20.1159	(87)
Th 2	20.0679	20.0705	20.0705	20.0741	20.0741	20.0785	20.0774	20.0795	20.0785	20.0764	20.0764	20.0729	(88)
util rest of house													
	0.9883	0.9785	0.9467	0.8523	0.6731	0.4136	0.2391	0.2722	0.6155	0.9048	0.9769	0.9905	(89)
Tweekday	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
Tweekend	18.2560	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	
MIT 2	19.2496	18.4785	18.9274	19.4566	19.8111	19.9505	19.9659	19.9672	19.8910	19.4234	18.7577	18.2220	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5304	18.7798	19.1746	19.6708	20.0098	20.1464	20.1631	20.1637	20.0850	19.6387	19.0120	18.6134	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9868	0.9716	0.9352	0.8393	0.6690	0.4199	0.2484	0.2820	0.6161	0.8920	0.9696	0.9869	(94)
Useful gains	1303.1201	1511.4251	1749.6746	1914.5041	1672.3109	1096.4629	613.4863	637.4967	1200.5583	1395.1382	1287.4133	1217.0511	(95)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	3976.7018	3621.0218	3234.9709	2672.9287	1917.6058	1128.3876	616.6374	642.4537	1329.3770	2193.1670	3004.3874	3701.9281	(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	1989.1448	1417.6490	1105.0605	546.0657	182.4994	0.0000	0.0000	0.0000	0.0000	593.7334	1236.2214	1848.7485	(98)
Space heating												8919.1226	(98)
Space heating per m2											(98) / (4) =	32.9654	(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 %)												300.5677	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2967.4255	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1989.1448	1417.6490	1105.0605	546.0657	182.4994	0.0000	0.0000	0.0000	0.0000	593.7334	1236.2214	1848.7485	(98)
Space heating efficiency (main heating system 1)	300.5677	300.5677	300.5677	300.5677	300.5677	0.0000	0.0000	0.0000	0.0000	300.5677	300.5677	300.5677	(210)
Space heating fuel (main heating system)	661.7959	471.6571	367.6578	181.6781	60.7182	0.0000	0.0000	0.0000	0.0000	197.5373	411.2955	615.0855	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												2967.4255	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												709.9008	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =											-1824.1596	-1824.1596	(233)
Total delivered energy for all uses												2695.2365	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	2967.4255	42.0240	1247.0309	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	49.5400	292.0130	(245)
Low-rate cost	252.6210	11.9600	30.2135	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	709.9008	45.7820	325.0068	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	41.2510	-752.4841	(252)
Total energy cost			1141.7800	(255)

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	2967.4255	0.5190	1540.0938	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			1977.1281	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	709.9008	0.5190	368.4385	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			1398.8278	(272)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2967.4255	3.0700	9109.9964	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	842.0699	3.0700	2585.1545	(264)
Space and water heating			11695.1509	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	709.9008	3.0700	2179.3954	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			8274.3762	(272)
Primary energy kWh/m2/year			30.5824	(273)

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

Property Reference	P3 Oak	**Issued on Date**	16/01/2024
Assessment Reference	P3 Oak	**Prop Type Ref**	End
Property	1, Oakley		

SAP Rating	87 B	**DER**	10.44	**TER**	21.36
Environmental	89 B	**% DER<TER**	51.13		
CO_2 Emissions (t/year)	2.36	**DFEE**	44.88	**TFEE**	57.84
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.42		

Assessor Details	Mrs. Naomi Sadler, Sadler Energy & Environmental Services Ltd, Tel: 01962 718870, naomi.sadler@sadlerenergy.co.uk	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne		

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.9300	(2b) =	396.3704	(1b) - (3b)
First floor	135.2800	(1c)	x 2.4000	(2c) =	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		721.0424	(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							6 * 10 =		60.0000	(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) =		60.0000 / (5) =	0.0832	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2832	(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) =	0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	38.5000	173.7700	0.1900	33.0163	60.0000	10426.2000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		128.1469			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38264.4300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.4268 (35)
Thermal bridges (User defined value 0.034 * total exposed area)		19.1515 (36)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 147.2984 (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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.2722	274.4353	274.4353	273.2565	273.2565	271.8276	272.1696	271.4959	271.8276	272.5217	272.5217	273.6392	(39)
Average = Sum(39)m / 12 =												273.0549	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0174	1.0143	1.0143	1.0100	1.0100	1.0047	1.0059	1.0035	1.0047	1.0073	1.0073	1.0114	(40)
HLP (average)												1.0092	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)
Average daily hot water use (litres/day) 107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)
Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
								Total per year (kWh/year) = Sum(64)m =				2303.1032	(64)
RHI water heating demand												2303	(64)
Heat gains from water heating, kWh/month	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.9017	89.6200	72.8839	55.1778	41.2460	34.8216	37.6260	48.9077	65.6438	83.3499	97.2816	103.7060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains	1001.2480	994.2003	955.3620	894.5769	830.5707	774.9489	743.7187	755.2699	791.4269	852.4580	920.1119	972.9970	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	11.9814	0.7200	0.7000	0.7700	36.7424	(74)
East	12.9200	22.3313	0.7200	0.7000	0.7700	100.7722	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	305.9881	537.5224	877.4305	1332.7214	1609.3764	1773.2814	1665.7305	1448.8464	1110.0536	681.2968	390.4834	249.5257	(83)
Total gains	1307.2362	1531.7227	1832.7924	2227.2983	2439.9471	2548.2303	2409.4492	2204.1163	1901.4805	1533.7548	1310.5953	1222.5227	(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	38.6127	38.7305	38.7305	38.8975	38.8975	39.1020	39.0529	39.1498	39.1020	39.0024	39.0024	38.8431
alpha	3.5742	3.5820	3.5820	3.5932	3.5932	3.6068	3.6035	3.6100	3.6068	3.6002	3.6002	3.5895
util living area												

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	0.9906	0.9830	0.9586	0.8844	0.7374	0.5061	0.3449	0.3858	0.7045	0.9301	0.9823	0.9924	(86)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	20.1312	20.2268	20.4252	20.6679	20.8483	20.9330	20.9482	20.9467	20.8883	20.6486	20.3496	20.1151	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6076	19.9307	20.1129	20.4815	20.7659	20.8971	20.9201	20.9177	20.8256	20.4577	19.9845	20.1151	(87)
Th 2	20.0688	20.0714	20.0714	20.0750	20.0750	20.0794	20.0784	20.0805	20.0794	20.0773	20.0773	20.0739	(88)
util rest of house													
	0.9887	0.9795	0.9496	0.8597	0.6838	0.4227	0.2449	0.2788	0.6265	0.9093	0.9778	0.9908	(89)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
MIT 2	19.2490	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9873	0.9729	0.9385	0.8466	0.6792	0.4290	0.2543	0.2888	0.6267	0.8966	0.9708	0.9873	(94)
Useful gains	1290.6184	1490.1684	1720.0302	1885.5876	1657.2994	1093.0941	612.7822	636.6035	1191.6425	1375.2226	1272.2987	1207.0232	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	3972.1005	3614.8280	3227.6138	2666.1190	1913.7580	1127.0336	616.1561	641.9171	1326.9989	2188.2344	2999.6328	3697.4891	(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													
	1995.0226	1427.7712	1121.6422	561.9826	190.8052	0.0000	0.0000	0.0000	0.0000	604.8808	1243.6806	1852.9066	(98)
Space heating												8998.6918	(98)
RHI space heating demand												8999	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.9300	(2b) =	396.3704	(1b) - (3b)
First floor	135.2800	(1c)	x 2.4000	(2c) =	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		721.0424	(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							6 * 10 =		60.0000	(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) =	60.0000 / (5) =	0.0832	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2832	(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) =	0.2620	(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	0.3340	0.3275	0.3209	0.2882	0.2816	0.2489	0.2489	0.2423	0.2620	0.2816	0.2947	0.3078	(22b)
Effective ac	0.5558	0.5536	0.5515	0.5415	0.5397	0.5310	0.5310	0.5294	0.5343	0.5397	0.5434	0.5474	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	38.5000	173.7700	0.1900	33.0163	60.0000	10426.2000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.1469			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38264.4300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.4268 (35)
Thermal bridges (User defined value 0.034 * total exposed area)		19.1515 (36)
Total fabric heat loss	(33) + (36) =	147.2984 (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	132.2452	131.7297	131.2245	128.8516	128.4076	126.3409	126.3409	125.9581	127.1370	128.4076	129.3058	130.2447	(38)
Heat transfer coeff	279.5435	279.0281	278.5229	276.1500	275.7060	273.6392	273.6392	273.2565	274.4353	275.7060	276.6041	277.5431	(39)
Average = Sum(39)m / 12 =												276.1478	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0332	1.0313	1.0294	1.0207	1.0190	1.0114	1.0114	1.0100	1.0143	1.0190	1.0223	1.0258	(40)
HLP (average)												1.0207	(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		3.0937 (42)
Average daily hot water use (litres/day)		107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.9017	89.6200	72.8839	55.1778	41.2460	34.8216	37.6260	48.9077	65.6438	83.3499	97.2816	103.7060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1001.2480	994.2003	955.3620	894.5769	830.5707	774.9489	743.7187	755.2699	791.4269	852.4580	920.1119	972.9970	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)
East	12.9200	19.6403	0.7200	0.7000	0.7700	88.6285	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1270.6566	1519.7479	1824.1286	2177.2736	2423.2385	2416.0627	2301.6096	2078.4495	1805.9982	1476.3004	1255.6005	1194.9139	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.0227	38.0930	38.1621	38.4900	38.5520	38.8431	38.8431	38.8975	38.7305	38.5520	38.4268	38.2968	
alpha	3.5348	3.5395	3.5441	3.5660	3.5701	3.5895	3.5895	3.5932	3.5820	3.5701	3.5618	3.5531	
util living area													
	0.9927	0.9856	0.9663	0.9119	0.8027	0.6434	0.4974	0.5612	0.7999	0.9524	0.9874	0.9941	(86)
Tweekday	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
Tweekend	20.0482	20.1571	20.3473	20.5906	20.7865	20.8989	20.9356	20.9273	20.8317	20.5625	20.2589	20.0285	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	13	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	9	7	0	0	0	0	0	0	0	0	0	22	
MIT	20.6009	19.8575	19.9926	20.3608	20.6705	20.8448	20.9006	20.8878	20.7372	20.3247	19.8427	20.0285	(87)
Th 2	20.0558	20.0573	20.0589	20.0662	20.0675	20.0739	20.0739	20.0750	20.0714	20.0675	20.0648	20.0619	(88)
util rest of house													
	0.9912	0.9827	0.9593	0.8932	0.7616	0.5723	0.4027	0.4642	0.7423	0.9387	0.9844	0.9929	(89)
Tweekday	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
Tweekend	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
MIT 2	19.2174	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.5033	18.6242	18.9908	19.4950	19.8837	20.0906	20.1459	20.1368	19.9787	19.4475	18.8085	18.4324	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5033	18.6242	18.9908	19.4950	19.8837	20.0906	20.1459	20.1368	19.9787	19.4475	18.8085	18.4324	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9768	0.9490	0.8796	0.7525	0.5737	0.4104	0.4711	0.7357	0.9269	0.9788	0.9900	(94)
Useful gains	1258.1237	1484.4179	1731.1598	1915.0428	1823.4803	1386.0361	944.5458	979.0887	1328.6682	1368.3930	1228.9370	1182.9540	(95)

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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	4249.9833	3829.4418	3478.9784	2925.8040	2256.2857	1502.4431	970.3066	1021.0994	1613.3199	2439.2967	3238.6092	3950.1020	(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	2225.9436	1575.8561	1300.3770	727.7481	322.0072	0.0000	0.0000	0.0000	0.0000	796.7523	1446.9640	2058.7581	(98)
Space heating												10454.4064	(98)
Space heating per m2											(98) / (4) =	38.6399	(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 %)												300.3335	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3480.9320	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2225.9436	1575.8561	1300.3770	727.7481	322.0072	0.0000	0.0000	0.0000	0.0000	796.7523	1446.9640	2058.7581	(98)
Space heating efficiency (main heating system 1)	300.3335	300.3335	300.3335	300.3335	300.3335	0.0000	0.0000	0.0000	0.0000	300.3335	300.3335	300.3335	(210)
Space heating fuel (main heating system)	741.1572	524.7020	432.9776	242.3133	107.2165	0.0000	0.0000	0.0000	0.0000	265.2892	481.7857	685.4906	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												3480.9320	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												712.7820	(232)
Total delivered energy for all uses												5035.7838	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	3480.9320	13.3320	464.0779	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	15.2900	90.1267	(245)
Low-rate cost	252.6210	5.5000	13.8942	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	712.7820	14.3110	102.0062	(250)
Additional standing charges			24.0000	(251)
Total energy cost			694.1050	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9238	(257)
SAP value		87.1126	
SAP rating (Section 12)		87	(258)
SAP band		B	

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	3480.9320	0.5190	1806.6037	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			2243.6380	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	712.7820	0.5190	369.9338	(268)
Total kg/year			2613.5718	(272)
CO2 emissions per m2			9.6600	(273)
EI value			88.9017	
EI rating			89	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	13.33 × (1 + 0.29 × 0.25) / 3.0033 = 4.761, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 3.0033 = 0.1853, stars = 5
Water heating energy efficiency	12.35 / 2.7351 = 4.517, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10	=	60.0000	(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) =	60.0000	/ (5) =	0.0832	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2832	(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)	=	0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	38.5000	173.7700	0.1900	33.0163	60.0000	10426.2000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.1469			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38264.4300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.4268	(35)
Thermal bridges (User defined value 0.034 * total exposed area)		19.1515	(36)
Total fabric heat loss	(33) + (36) =	147.2984	(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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.2722	274.4353	274.4353	273.2565	273.2565	271.8276	272.1696	271.4959	271.8276	272.5217	272.5217	273.6392	(39)
Average = Sum(39)m / 12 =												273.0549	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0174	1.0143	1.0143	1.0100	1.0100	1.0047	1.0059	1.0035	1.0047	1.0073	1.0073	1.0114	(40)
HLP (average)												1.0092	(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	3.0937	(42)
Average daily hot water use (litres/day)	107.6744	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.9017	89.6200	72.8839	55.1778	41.2460	34.8216	37.6260	48.9077	65.6438	83.3499	97.2816	103.7060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1001.2480	994.2003	955.3620	894.5769	830.5707	774.9489	743.7187	755.2699	791.4269	852.4580	920.1119	972.9970	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	11.9814	0.7200	0.7000	0.7700	36.7424	(74)
East	12.9200	22.3313	0.7200	0.7000	0.7700	100.7722	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	305.9881	537.5224	877.4305	1332.7214	1609.3764	1773.2814	1665.7305	1448.8464	1110.0536	681.2968	390.4834	249.5257	(83)
Total gains	1307.2362	1531.7227	1832.7924	2227.2983	2439.9471	2548.2303	2409.4492	2204.1163	1901.4805	1533.7548	1310.5953	1222.5227	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6127	38.7305	38.7305	38.8975	38.8975	39.1020	39.0529	39.1498	39.1020	39.0024	39.0024	38.8431	
alpha	3.5742	3.5820	3.5820	3.5932	3.5932	3.6068	3.6035	3.6100	3.6068	3.6002	3.6002	3.5895	
util living area													
	0.9906	0.9830	0.9586	0.8844	0.7374	0.5061	0.3449	0.3858	0.7045	0.9301	0.9823	0.9924	(86)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	20.1312	20.2268	20.4252	20.6679	20.8483	20.9330	20.9482	20.9467	20.8883	20.6486	20.3496	20.1151	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6076	19.9307	20.1129	20.4815	20.7659	20.8971	20.9201	20.9177	20.8256	20.4577	19.9845	20.1151	(87)
Th 2	20.0688	20.0714	20.0714	20.0750	20.0750	20.0794	20.0784	20.0805	20.0794	20.0773	20.0773	20.0739	(88)
util rest of house													
	0.9887	0.9795	0.9496	0.8597	0.6838	0.4227	0.2449	0.2788	0.6265	0.9093	0.9778	0.9908	(89)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
MIT 2	19.2490	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9873	0.9729	0.9385	0.8466	0.6792	0.4290	0.2543	0.2888	0.6267	0.8966	0.9708	0.9873	(94)
Useful gains	1290.6184	1490.1684	1720.0302	1885.5876	1657.2994	1093.0941	612.7822	636.6035	1191.6425	1375.2226	1272.2987	1207.0232	(95)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	3972.1005	3614.8280	3227.6138	2666.1190	1913.7580	1127.0336	616.1561	641.9171	1326.9989	2188.2344	2999.6328	3697.4891 (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	1995.0226	1427.7712	1121.6422	561.9826	190.8052	0.0000	0.0000	0.0000	0.0000	604.8808	1243.6806	1852.9066 (98)
Space heating												8998.6918 (98)
Space heating per m2											(98) / (4) =	33.2595 (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 %)												300.5937	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2993.6395	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1995.0226	1427.7712	1121.6422	561.9826	190.8052	0.0000	0.0000	0.0000	0.0000	604.8808	1243.6806	1852.9066	(98)
Space heating efficiency (main heating system 1)	300.5937	300.5937	300.5937	300.5937	300.5937	0.0000	0.0000	0.0000	0.0000	300.5937	300.5937	300.5937	(210)
Space heating fuel (main heating system)	663.6941	474.9837	373.1423	186.9575	63.4761	0.0000	0.0000	0.0000	0.0000	201.2287	413.7414	616.4157	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												2993.6395	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												712.7820	(232)
Total delivered energy for all uses												4548.4913	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	2993.6395	42.0240	1258.0471	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	49.5400	292.0130	(245)
Low-rate cost	252.6210	11.9600	30.2135	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	712.7820	45.7820	326.3258	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1906.5994	(255)

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	2993.6395	0.5190	1553.6989	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			1990.7332	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	712.7820	0.5190	369.9338	(268)
Total kg/year			2360.6670	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2993.6395	3.0700	9190.4732	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	842.0699	3.0700	2585.1545	(264)
Space and water heating			11775.6277	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	712.7820	3.0700	2188.2406	(268)
Primary energy kWh/year			13963.8684	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/m2/year 51.6110 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 4.4	-£ 752	-947 kg (40.1%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 114	-159 kg (6.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£752	3.50 kg/m²	A 92	A 93
Total Savings	£752	3.50 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1907	£1907	£0
Space heating	£1258	£1258	£0
Water heating	£322	£322	£0
Lighting	£326	£326	£0
Generated (PV)	-£0	-£752	£752
Total cost of fuels	£1907	£1155	£752
Total cost of uses	£1906	£1154	£752
Delivered energy	17 kWh/m²	10 kWh/m²	7 kWh/m²
Carbon dioxide emissions	2.4 tonnes	1.4 tonnes	0.9 tonnes
CO2 emissions per m²	9 kg/m²	5 kg/m²	3 kg/m²
Primary energy	52 kWh/m²	31 kWh/m²	21 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10	=	60.0000	(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) =			60.0000 / (5) =	0.0832	(8)
Pressure test				Yes	
Measured/design AP50				4.0000	
Infiltration rate				0.2832	(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) =	0.2620	(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	0.3340	0.3275	0.3209	0.2882	0.2816	0.2489	0.2489	0.2423	0.2620	0.2816	0.2947	0.3078	(22b)
Effective ac	0.5558	0.5536	0.5515	0.5415	0.5397	0.5310	0.5310	0.5294	0.5343	0.5397	0.5434	0.5474	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	38.5000	173.7700	0.1900	33.0163	60.0000	10426.2000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.1469			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38264.4300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.4268 (35)
Thermal bridges (User defined value 0.034 * total exposed area)		19.1515 (36)
Total fabric heat loss	(33) + (36) =	147.2984 (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	132.2452	131.7297	131.2245	128.8516	128.4076	126.3409	126.3409	125.9581	127.1370	128.4076	129.3058	130.2447	(38)
Heat transfer coeff	279.5435	279.0281	278.5229	276.1500	275.7060	273.6392	273.6392	273.2565	274.4353	275.7060	276.6041	277.5431	(39)
Average = Sum(39)m / 12 =												276.1478	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0332	1.0313	1.0294	1.0207	1.0190	1.0114	1.0114	1.0100	1.0143	1.0190	1.0223	1.0258	(40)
HLP (average)												1.0207	(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		3.0937 (42)
Average daily hot water use (litres/day)		107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
								Total per year (kWh/year) = Sum(64)m =				2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.9017	89.6200	72.8839	55.1778	41.2460	34.8216	37.6260	48.9077	65.6438	83.3499	97.2816	103.7060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1001.2480	994.2003	955.3620	894.5769	830.5707	774.9489	743.7187	755.2699	791.4269	852.4580	920.1119	972.9970	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)
East	12.9200	19.6403	0.7200	0.7000	0.7700	88.6285	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1270.6566	1519.7479	1824.1286	2177.2736	2423.2385	2416.0627	2301.6096	2078.4495	1805.9982	1476.3004	1255.6005	1194.9139	(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	38.0227	38.0930	38.1621	38.4900	38.5520	38.8431	38.8431	38.8975	38.7305	38.5520	38.4268	38.2968	
alpha	3.5348	3.5395	3.5441	3.5660	3.5701	3.5895	3.5895	3.5932	3.5820	3.5701	3.5618	3.5531	
util living area													
	0.9927	0.9856	0.9663	0.9119	0.8027	0.6434	0.4974	0.5612	0.7999	0.9524	0.9874	0.9941	(86)
Tweekday	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
Tweekend	20.0482	20.1571	20.3473	20.5906	20.7865	20.8989	20.9356	20.9273	20.8317	20.5625	20.2589	20.0285	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	13	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	9	7	0	0	0	0	0	0	0	0	0	22	
MIT	20.6009	19.8575	19.9926	20.3608	20.6705	20.8448	20.9006	20.8878	20.7372	20.3247	19.8427	20.0285	(87)
Th 2	20.0558	20.0573	20.0589	20.0662	20.0675	20.0739	20.0739	20.0750	20.0714	20.0675	20.0648	20.0619	(88)
util rest of house													
	0.9912	0.9827	0.9593	0.8932	0.7616	0.5723	0.4027	0.4642	0.7423	0.9387	0.9844	0.9929	(89)
Tweekday	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
Tweekend	18.0566	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	
MIT 2	19.2174	18.3030	18.7299	19.2695	19.6787	19.8942	19.9494	19.9412	19.7811	19.2190	18.5391	18.0166	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5033	18.6242	18.9908	19.4950	19.8837	20.0906	20.1459	20.1368	19.9787	19.4475	18.8085	18.4324	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5033	18.6242	18.9908	19.4950	19.8837	20.0906	20.1459	20.1368	19.9787	19.4475	18.8085	18.4324	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9768	0.9490	0.8796	0.7525	0.5737	0.4104	0.4711	0.7357	0.9269	0.9788	0.9900	(94)
Useful gains	1258.1237	1484.4179	1731.1598	1915.0428	1823.4803	1386.0361	944.5458	979.0887	1328.6682	1368.3930	1228.9370	1182.9540	(95)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	4249.9833	3829.4418	3478.9784	2925.8040	2256.2857	1502.4431	970.3066	1021.0994	1613.3199	2439.2967	3238.6092	3950.1020	(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	2225.9436	1575.8561	1300.3770	727.7481	322.0072	0.0000	0.0000	0.0000	0.0000	796.7523	1446.9640	2058.7581	(98)
Space heating												10454.4064	(98)
Space heating per m2											(98) / (4) =	38.6399	(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 %)												300.3335	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												3480.9320	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2225.9436	1575.8561	1300.3770	727.7481	322.0072	0.0000	0.0000	0.0000	0.0000	796.7523	1446.9640	2058.7581	(98)
Space heating efficiency (main heating system 1)	300.3335	300.3335	300.3335	300.3335	300.3335	0.0000	0.0000	0.0000	0.0000	300.3335	300.3335	300.3335	(210)
Space heating fuel (main heating system)	741.1572	524.7020	432.9776	242.3133	107.2165	0.0000	0.0000	0.0000	0.0000	265.2892	481.7857	685.4906	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												3480.9320	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												712.7820	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3308.5444	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	3480.9320	13.3320	464.0779	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	15.2900	90.1267	(245)
Low-rate cost	252.6210	5.5000	13.8942	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	712.7820	14.3110	102.0062	(250)
Additional standing charges			24.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	13.7505	-237.5041	(252)
Total energy cost			456.6009	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6077	(257)
SAP value		91.5223	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	3480.9320	0.5190	1806.6037	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			2243.6380	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy for lighting	712.7820	0.5190	369.9338 (268)
Energy saving/generation technologies			
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			1717.1346 (272)
CO2 emissions per m2			6.3500 (273)
EI value			92.7083
EI rating			93 (274)
EI band			A

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.9300 (2b)	=	396.3704	(1b) - (3b)
First floor	135.2800 (1c)	x	2.4000 (2c)	=	324.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	721.0424	(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							6 * 10	=	60.0000	(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) =	60.0000	/ (5) =	0.0832	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2832	(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) =		0.2620	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2751	0.2620	0.2620	0.2423	0.2423	0.2161	0.2227	0.2096	0.2161	0.2292	0.2292	0.2489	(22b)
Effective ac	0.5378	0.5343	0.5343	0.5294	0.5294	0.5234	0.5248	0.5220	0.5234	0.5263	0.5263	0.5310	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	212.2700	38.5000	173.7700	0.1900	33.0163	60.0000	10426.2000	(29a)
External Wall 2	80.4500	9.2800	71.1700	0.1800	12.8106	190.0000	13522.3000	(29a)
External Roof 1	130.1500		130.1500	0.0900	11.7135	9.0000	1171.3500	(30)
External Roof 2	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
Total net area of external elements Aum(A, m2)			563.2800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.1469			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.2800			18.0000	2435.0400	(32d)
Internal Ceiling 1			134.2700			18.0000	2416.8600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38264.4300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		141.4268	(35)
Thermal bridges (User defined value 0.034 * total exposed area)		19.1515	(36)
Total fabric heat loss	(33) + (36) =	147.2984	(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	127.9739	127.1370	127.1370	125.9581	125.9581	124.5293	124.8712	124.1976	124.5293	125.2233	125.2233	126.3409	(38)
Heat transfer coeff	275.2722	274.4353	274.4353	273.2565	273.2565	271.8276	272.1696	271.4959	271.8276	272.5217	272.5217	273.6392	(39)
Average = Sum(39)m / 12 =												273.0549	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0174	1.0143	1.0143	1.0100	1.0100	1.0047	1.0059	1.0035	1.0047	1.0073	1.0073	1.0114	(40)
HLP (average)												1.0092	(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		3.0937 (42)
Average daily hot water use (litres/day)		107.6744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.4418	114.1348	109.8279	105.5209	101.2139	96.9069	96.9069	101.2139	105.5209	109.8279	114.1348	118.4418	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	175.6458	153.6209	158.5230	138.2042	132.6102	114.4326	106.0386	121.6808	123.1341	143.5009	156.6425	170.1036	(45)
Energy content (annual)										Total = Sum(45)m =		1694.1372	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3469	23.0431	23.7785	20.7306	19.8915	17.1649	15.9058	18.2521	18.4701	21.5251	23.4964	25.5155	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(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													
	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
									Total per year (kWh/year) = Sum(64)m =			2303.1032	(64)
Heat gains from water heating, kWh/month													
	99.7785	88.4511	94.0852	85.9945	85.4692	78.0904	76.6342	81.8352	80.9837	89.0904	92.1252	97.9358	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	100.9017	89.6200	72.8839	55.1778	41.2460	34.8216	37.6260	48.9077	65.6438	83.3499	97.2816	103.7060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	134.1109	131.6237	126.4586	119.4368	114.8780	108.4589	103.0029	109.9935	112.4773	119.7451	127.9517	131.6341	(72)
Total internal gains													
	1001.2480	994.2003	955.3620	894.5769	830.5707	774.9489	743.7187	755.2699	791.4269	852.4580	920.1119	972.9970	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	11.9814	0.7200	0.7000	0.7700	36.7424	(74)
East	12.9200	22.3313	0.7200	0.7000	0.7700	100.7722	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	305.9881	537.5224	877.4305	1332.7214	1609.3764	1773.2814	1665.7305	1448.8464	1110.0536	681.2968	390.4834	249.5257	(83)
Total gains	1307.2362	1531.7227	1832.7924	2227.2983	2439.9471	2548.2303	2409.4492	2204.1163	1901.4805	1533.7548	1310.5953	1222.5227	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6127	38.7305	38.7305	38.8975	38.8975	39.1020	39.0529	39.1498	39.1020	39.0024	39.0024	38.8431	
alpha	3.5742	3.5820	3.5820	3.5932	3.5932	3.6068	3.6035	3.6100	3.6068	3.6002	3.6002	3.5895	
util living area													
	0.9906	0.9830	0.9586	0.8844	0.7374	0.5061	0.3449	0.3858	0.7045	0.9301	0.9823	0.9924	(86)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	20.1312	20.2268	20.4252	20.6679	20.8483	20.9330	20.9482	20.9467	20.8883	20.6486	20.3496	20.1151	
24 / 16	5	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	12	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	10	6	0	0	0	0	0	0	0	0	0	22	
MIT	20.6076	19.9307	20.1129	20.4815	20.7659	20.8971	20.9201	20.9177	20.8256	20.4577	19.9845	20.1151	(87)
Th 2	20.0688	20.0714	20.0714	20.0750	20.0750	20.0794	20.0784	20.0805	20.0794	20.0773	20.0773	20.0739	(88)
util rest of house													
	0.9887	0.9795	0.9496	0.8597	0.6838	0.4227	0.2449	0.2788	0.6265	0.9093	0.9778	0.9908	(89)
Tweekday	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
Tweekend	18.2534	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	
MIT 2	19.2490	18.4700	18.9130	19.4420	19.8050	19.9505	19.9669	19.9681	19.8880	19.4139	18.7523	18.2208	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5297	18.7719	19.1609	19.6568	20.0035	20.1461	20.1639	20.1644	20.0818	19.6296	19.0070	18.6123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9873	0.9729	0.9385	0.8466	0.6792	0.4290	0.2543	0.2888	0.6267	0.8966	0.9708	0.9873	(94)
Useful gains	1290.6184	1490.1684	1720.0302	1885.5876	1657.2994	1093.0941	612.7822	636.6035	1191.6425	1375.2226	1272.2987	1207.0232	(95)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	3972.1005	3614.8280	3227.6138	2666.1190	1913.7580	1127.0336	616.1561	641.9171	1326.9989	2188.2344	2999.6328	3697.4891	(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	1995.0226	1427.7712	1121.6422	561.9826	190.8052	0.0000	0.0000	0.0000	0.0000	604.8808	1243.6806	1852.9066	(98)
Space heating												8998.6918	(98)
Space heating per m2											(98) / (4) =	33.2595	(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 %)												300.5937	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2993.6395	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1995.0226	1427.7712	1121.6422	561.9826	190.8052	0.0000	0.0000	0.0000	0.0000	604.8808	1243.6806	1852.9066	(98)
Space heating efficiency (main heating system 1)	300.5937	300.5937	300.5937	300.5937	300.5937	0.0000	0.0000	0.0000	0.0000	300.5937	300.5937	300.5937	(210)
Space heating fuel (main heating system)	663.6941	474.9837	373.1423	186.9575	63.4761	0.0000	0.0000	0.0000	0.0000	201.2287	413.7414	616.4157	(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	227.3662	200.3361	210.2434	188.2562	184.3306	164.4846	157.7590	173.4012	173.1861	195.2213	206.6945	221.8240	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	83.1305	73.2477	76.8701	68.8310	67.3957	60.1395	57.6805	63.3997	63.3210	71.3776	75.5725	81.1042	(219)
Water heating fuel used												842.0699	(219)
Annual totals kWh/year													
Space heating fuel - main system												2993.6395	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												712.7820	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =											-1824.1596	-1824.1596	(233)
Total delivered energy for all uses												2724.3317	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	2993.6395	42.0240	1258.0471	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	589.4489	49.5400	292.0130	(245)
Low-rate cost	252.6210	11.9600	30.2135	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	712.7820	45.7820	326.3258	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	41.2510	-752.4841	(252)
Total energy cost			1154.1153	(255)

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	2993.6395	0.5190	1553.6989	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	842.0699	0.5190	437.0343	(264)
Space and water heating			1990.7332	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	712.7820	0.5190	369.9338	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			1413.9281	(272)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2993.6395	3.0700	9190.4732	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	842.0699	3.0700	2585.1545	(264)
Space and water heating			11775.6277	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	712.7820	3.0700	2188.2406	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			8363.6983	(272)
Primary energy kWh/m2/year			30.9125	(273)

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

Property Reference	P4 Oak	**Issued on Date**	16/01/2024
Assessment Reference	P4 Oak	**Prop Type Ref**	End
Property	1, Oakley		

SAP Rating	86 B	**DER**	10.67	**TER**	21.01
Environmental	88 B	**% DER<TER**	49.20		
CO_2 Emissions (t/year)	3.06	**DFEE**	44.44	**TFEE**	58.57
General Requirements Compliance	Pass	**% DFEE<TFEE**	24.12		

Assessor Details	Mrs. Naomi Sadler, Sadler Energy & Environmental Services Ltd, Tel: 01962 718870, naomi.sadler@sadlerenergy.co.uk	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne		

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.9300 (2b)	=	498.6860	(1b) - (3b)
First floor	170.2000 (1c)	x	2.4000 (2c)	=	408.4800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	907.1660	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0661	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2661	(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) =	0.2462	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2585	0.2462	0.2462	0.2277	0.2277	0.2031	0.2093	0.1969	0.2031	0.2154	0.2154	0.2339	(22b)
Effective ac	0.5334	0.5303	0.5303	0.5259	0.5259	0.5206	0.5219	0.5194	0.5206	0.5232	0.5232	0.5273	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	222.7700	55.3000	167.4700	0.1900	31.8193	60.0000	10048.2000	(29a)
External Wall 2	80.4500	18.3800	62.0700	0.1900	11.7933	190.0000	11793.3000	(29a)
External Roof 1	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			620.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		161.6448			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			18.0000	3063.6000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38577.8000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		113.3308 (35)
Thermal bridges (User defined value 0.032 * total exposed area)		19.8637 (36)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total fabric heat loss (33) + (36) = 181.5084 (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	159.6836	158.7538	158.7538	157.4441	157.4441	155.8566	156.2365	155.4881	155.8566	156.6277	156.6277	157.8693	(38)
Heat transfer coeff	341.1921	340.2622	340.2622	338.9526	338.9526	337.3651	337.7449	336.9965	337.3651	338.1361	338.1361	339.3778	(39)
Average = Sum(39)m / 12 =												338.7286	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0023	0.9996	0.9996	0.9957	0.9957	0.9911	0.9922	0.9900	0.9911	0.9933	0.9933	0.9970	(40)
HLP (average)												0.9951	(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 3.1845 (42)
Average daily hot water use (litres/day) 109.8307 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.8138	116.4205	112.0273	107.6341	103.2408	98.8476	98.8476	103.2408	107.6341	112.0273	116.4205	120.8138	(44)
Energy conte	179.1633	156.6974	161.6977	140.9719	135.2659	116.7242	108.1621	124.1176	125.6000	146.3747	159.7794	173.5101	(45)
Energy content (annual)										Total = Sum(45)m =		1728.0644	(45)
Distribution loss (46)m = 0.15 x (45)m	26.8745	23.5046	24.2546	21.1458	20.2899	17.5086	16.2243	18.6176	18.8400	21.9562	23.9669	26.0265	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(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	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
									Total per year (kWh/year) = Sum(64)m =			2337.0304	(64)
RHI water heating demand												2337	(64)
Heat gains from water heating, kWh/month	100.9481	89.4740	95.1408	86.9148	86.3522	78.8524	77.3402	82.6454	81.8036	90.0459	93.1683	99.0684	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.6162	106.2421	86.4019	65.4118	48.8961	41.2801	44.6046	57.9788	77.8190	98.8091	115.3248	122.9407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)	135.6830	133.1459	127.8774	120.7150	116.0648	109.5172	103.9519	111.0826	113.6161	121.0294	129.4004	133.1565	(72)
Total internal gains	1107.9421	1099.6233	1055.3821	986.4986	913.9174	851.4306	816.9069	829.8193	871.3256	940.4599	1016.7619	1076.4573	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	11.9814	0.7200	0.7000	0.7700	76.9163	(74)
East	5.9900	22.3313	0.7200	0.7000	0.7700	46.7202	(76)
South	14.8400	50.9848	0.7200	0.7000	0.7700	264.2644	(78)
West	4.2500	22.3313	0.7200	0.7000	0.7700	33.1487	(80)

Solar gains	421.0496	662.3946	942.4501	1288.5368	1483.5446	1612.8363	1523.0330	1367.3103	1135.9395	795.1500	520.1207	354.7292	(83)
Total gains	1528.9917	1762.0179	1997.8321	2275.0354	2397.4620	2464.2669	2339.9399	2197.1296	2007.2650	1735.6099	1536.8826	1431.1865	(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	31.4077	31.4935	31.4935	31.6152	31.6152	31.7640	31.7283	31.7987	31.7640	31.6915	31.6915	31.5756
alpha	3.0938	3.0996	3.0996	3.1077	3.1077	3.1176	3.1152	3.1199	3.1176	3.1128	3.1128	3.1050

CALCULATION OF HEAT DEMAND 09 Jan 2014

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util living area
                0.9856    0.9771    0.9566    0.9052    0.8009    0.6007    0.4265    0.4622    0.7474    0.9247    0.9750    0.9880 (86)

Tweekday       17.9323   18.1543   18.5988   19.1533   19.6306   19.9026   19.9553   19.9543   19.8024   19.2323   18.5026   17.8962
Tweekend       19.9749   20.0730   20.2715   20.5219   20.7479   20.8929   20.9320   20.9286   20.8309   20.5538   20.2254   19.9574
24 / 16            9         0         0         0         0         0         0         0         0         0         0         9
24 / 9            22         2         0         0         0         0         0         0         0         0         0        22
16 / 9             0        18        15         0         0         0         0         0         0         0         0         0
MIT            21.0000   20.1392   20.1455   20.2535   20.6109   20.8355   20.8950   20.8898   20.7359   20.3113   19.7905   21.0000 (87)
Th 2           20.0814   20.0837   20.0837   20.0869   20.0869   20.0908   20.0898   20.0917   20.0908   20.0889   20.0889   20.0858 (88)
util rest of house
                0.9831    0.9731    0.9485    0.8862    0.7573    0.5155    0.3100    0.3426    0.6786    0.9055    0.9698    0.9859 (89)
Tweekday       17.9323   18.1543   18.5988   19.1533   19.6306   19.9026   19.9553   19.9543   19.8024   19.2323   18.5026   17.8962
Tweekend       17.9323   18.1543   18.5988   19.1533   19.6306   19.9026   19.9553   19.9543   19.8024   19.2323   18.5026   17.8962
MIT 2          20.0814   18.2921   18.5988   19.1533   19.6306   19.9026   19.9553   19.9543   19.8024   19.2323   18.5026   20.0858 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.1501 (91)
MIT            20.2193   18.5694   18.8311   19.3185   19.7778   20.0427   20.0964   20.0948   19.9426   19.3943   18.6960   20.2231 (92)
Temperature adjustment                                                                                                    0.0000
adjusted MIT   20.2193   18.5694   18.8311   19.3185   19.7778   20.0427   20.0964   20.0948   19.9426   19.3943   18.6960   20.2231 (93)


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8. Space heating requirement
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                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9835    0.9643    0.9340    0.8665    0.7402    0.5106    0.3109    0.3431    0.6657    0.8866    0.9587    0.9863 (94)
Useful gains 1503.8270 1699.0669 1866.0261 1971.3982 1774.5670 1258.3050  727.5576  753.7897 1336.2192 1538.8389 1473.4257 1411.5130 (95)
Ext temp.       5.1000    5.6000    7.4000    9.9000   13.0000   16.0000   17.9000   17.8000   15.2000   11.6000    8.0000    5.1000 (96)
Heat loss rate W
             5158.5920 4413.0101 3889.5610 3192.4088 2297.3570 1363.8493  741.8260  773.3348 1599.9781 2635.5361 3616.6951 5132.4424 (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
             2719.1452 1823.7698 1505.5099  879.1276  388.9558    0.0000    0.0000    0.0000    0.0000  815.9427 1543.1539 2768.3715 (98)
Space heating                                                                                                       12443.9765 (98)
RHI space heating demand                                                                                                12444 (98)


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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.9300	(2b) =	498.6860	(1b) - (3b)
First floor	170.2000	(1c)	x 2.4000	(2c) =	408.4800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		907.1660	(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							6 * 10 =		60.0000	(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) =	60.0000	/ (5) =	0.0661	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2661	(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) =		0.2462	(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	0.3139	0.3077	0.3016	0.2708	0.2646	0.2339	0.2339	0.2277	0.2462	0.2646	0.2770	0.2893	(22b)
Effective ac	0.5493	0.5473	0.5455	0.5367	0.5350	0.5273	0.5273	0.5259	0.5303	0.5350	0.5384	0.5418	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	222.7700	55.3000	167.4700	0.1900	31.8193	60.0000	10048.2000	(29a)
External Wall 2	80.4500	18.3800	62.0700	0.1900	11.7933	190.0000	11793.3000	(29a)
External Roof 1	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			620.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		161.6448			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			18.0000	3063.6000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 38577.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	113.3308	(35)
Thermal bridges (User defined value 0.032 * total exposed area)	19.8637	(36)
Total fabric heat loss	(33) + (36) = 181.5084	(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	164.4291	163.8565	163.2952	160.6588	160.1655	157.8693	157.8693	157.4441	158.7538	160.1655	161.1634	162.2066	(38)
Heat transfer coeff	345.9375	345.3649	344.8036	342.1672	341.6740	339.3778	339.3778	338.9526	340.2622	341.6740	342.6718	343.7150	(39)
Average = Sum(39)m / 12 =												342.1649	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0163	1.0146	1.0129	1.0052	1.0037	0.9970	0.9970	0.9957	0.9996	1.0037	1.0067	1.0097	(40)
HLP (average)												1.0052	(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	3.1845 (42)
Average daily hot water use (litres/day)	109.8307 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.8138	116.4205	112.0273	107.6341	103.2408	98.8476	98.8476	103.2408	107.6341	112.0273	116.4205	120.8138	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	179.1633	156.6974	161.6977	140.9719	135.2659	116.7242	108.1621	124.1176	125.6000	146.3747	159.7794	173.5101	(45)
Energy content (annual)										Total = Sum(45)m =		1728.0644	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.8745	23.5046	24.2546	21.1458	20.2899	17.5086	16.2243	18.6176	18.8400	21.9562	23.9669	26.0265	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
									Total per year (kWh/year) = Sum(64)m =			2337.0304	(64)
Heat gains from water heating, kWh/month													
	100.9481	89.4740	95.1408	86.9148	86.3522	78.8524	77.3402	82.6454	81.8036	90.0459	93.1683	99.0684	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	119.6162	106.2421	86.4019	65.4118	48.8961	41.2801	44.6046	57.9788	77.8190	98.8091	115.3248	122.9407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	135.6830	133.1459	127.8774	120.7150	116.0648	109.5172	103.9519	111.0826	113.6161	121.0294	129.4004	133.1565	(72)
Total internal gains													
	1107.9421	1099.6233	1055.3821	986.4986	913.9174	851.4306	816.9069	829.8193	871.3256	940.4599	1016.7619	1076.4573	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1488.7739	1764.3550	2008.8895	2243.9699	2393.4444	2351.9557	2250.3496	2092.4597	1929.1347	1686.8561	1475.7966	1400.5208	(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	30.9769	31.0282	31.0787	31.3182	31.3634	31.5756	31.5756	31.6152	31.4935	31.3634	31.2721	31.1772	
alpha	3.0651	3.0685	3.0719	3.0879	3.0909	3.1050	3.1050	3.1077	3.0996	3.0909	3.0848	3.0785	
util living area													
	0.9883	0.9796	0.9627	0.9247	0.8502	0.7255	0.5868	0.6366	0.8246	0.9449	0.9813	0.9903	(86)
Tweekday	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
Tweekend	19.8834	19.9996	20.1880	20.4334	20.6613	20.8286	20.9012	20.8877	20.7565	20.4593	20.1250	19.8612	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	9	
24 / 9	22	3	0	0	0	0	0	0	0	0	0	22	
16 / 9	0	17	17	0	0	0	0	0	0	0	0	0	
MIT	21.0000	20.1068	20.0877	20.1153	20.4772	20.7367	20.8475	20.8267	20.6197	20.1656	19.6337	21.0000	(87)
Th 2	20.0698	20.0712	20.0726	20.0790	20.0802	20.0858	20.0858	20.0869	20.0837	20.0802	20.0778	20.0752	(88)
util rest of house													
	0.9864	0.9762	0.9561	0.9102	0.8185	0.6621	0.4892	0.5421	0.7761	0.9315	0.9775	0.9887	(89)
Tweekday	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
Tweekend	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
MIT 2	20.0698	18.2043	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	20.0752	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	20.2095	18.4899	18.6567	19.1280	19.6011	19.9304	20.0531	20.0351	19.7992	19.1908	18.4740	20.2141	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2095	18.4899	18.6567	19.1280	19.6011	19.9304	20.0531	20.0351	19.7992	19.1908	18.4740	20.2141	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9867	0.9684	0.9428	0.8914	0.7990	0.6500	0.4854	0.5362	0.7580	0.9144	0.9683	0.9889	(94)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	1468.9340	1708.6156	1893.9132	2000.2317	1912.2754	1528.7396	1092.3886	1121.9105	1462.3628	1542.3887	1429.0657	1385.0138	(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	5503.6813	4693.4793	4191.6691	3499.6846	2699.6032	1809.0290	1171.9159	1232.1261	1939.2271	2935.2641	3897.5433	5504.2793	(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	3001.8520	2005.8284	1709.5304	1079.6061	585.7719	0.0000	0.0000	0.0000	0.0000	1036.2992	1777.3038	3064.7336	(98)
Space heating												14260.9255	(98)
Space heating per m2											(98) / (4) =	41.8946	(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 %)												295.9702	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4818.3649	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3001.8520	2005.8284	1709.5304	1079.6061	585.7719	0.0000	0.0000	0.0000	0.0000	1036.2992	1777.3038	3064.7336	(98)
Space heating efficiency (main heating system 1)	295.9702	295.9702	295.9702	295.9702	295.9702	0.0000	0.0000	0.0000	0.0000	295.9702	295.9702	295.9702	(210)
Space heating fuel (main heating system)	1014.2412	677.7129	577.6021	364.7685	197.9158	0.0000	0.0000	0.0000	0.0000	350.1363	600.5009	1035.4871	(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	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	84.4166	74.3725	78.0308	69.8429	68.3667	60.9774	58.4569	64.2906	64.2226	72.4283	76.7194	82.3497	(219)
Water heating fuel used												854.4745	(219)
Annual totals kWh/year													
Space heating fuel - main system												4818.3649	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												844.9840	(232)
Total delivered energy for all uses												6517.8233	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	4818.3649	13.3320	642.3844	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	598.1321	15.2900	91.4544	(245)
Low-rate cost	256.3423	5.5000	14.0988	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	844.9840	14.3110	120.9257	(250)
Additional standing charges			24.0000	(251)
Total energy cost			892.8633	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9730	(257)
SAP value		86.4263	
SAP rating (Section 12)		86	(258)
SAP band		B	

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	4818.3649	0.5190	2500.7314	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	854.4745	0.5190	443.4722	(264)
Space and water heating			2944.2036	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	844.9840	0.5190	438.5467	(268)
Total kg/year			3382.7503	(272)
CO2 emissions per m2			9.9400	(273)
EI value			88.2385	
EI rating			88	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.33 × (1 + 0.29 × 0.25) / 2.9597 = 4.831, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 2.9597 = 0.1881, stars = 5
Water heating energy efficiency	12.35 / 2.7351 = 4.517, stars = 4
Water heating environmental impact	0.519 / 2.7351 = 0.1898, stars = 5

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.9300	(2b) =	498.6860	(1b) - (3b)
First floor	170.2000	(1c)	x 2.4000	(2c) =	408.4800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	907.1660	(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							6 * 10	=	60.0000	(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) =	60.0000 / (5) =	0.0661	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2661	(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) =	0.2462	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2585	0.2462	0.2462	0.2277	0.2277	0.2031	0.2093	0.1969	0.2031	0.2154	0.2154	0.2339	(22b)
Effective ac	0.5334	0.5303	0.5303	0.5259	0.5259	0.5206	0.5219	0.5194	0.5206	0.5232	0.5232	0.5273	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	222.7700	55.3000	167.4700	0.1900	31.8193	60.0000	10048.2000	(29a)
External Wall 2	80.4500	18.3800	62.0700	0.1900	11.7933	190.0000	11793.3000	(29a)
External Roof 1	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			620.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	161.6448			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			18.0000	3063.6000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 38577.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	113.3308	(35)
Thermal bridges (User defined value 0.032 * total exposed area)	19.8637	(36)
Total fabric heat loss	(33) + (36) = 181.5084	(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	159.6836	158.7538	158.7538	157.4441	157.4441	155.8566	156.2365	155.4881	155.8566	156.6277	156.6277	157.8693	(38)
Heat transfer coeff	341.1921	340.2622	340.2622	338.9526	338.9526	337.3651	337.7449	336.9965	337.3651	338.1361	338.1361	339.3778	(39)
Average = Sum(39)m / 12 =												338.7286	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0023	0.9996	0.9996	0.9957	0.9957	0.9911	0.9922	0.9900	0.9911	0.9933	0.9933	0.9970	(40)
HLP (average)												0.9951	(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	3.1845	(42)
Average daily hot water use (litres/day)	109.8307	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.8138	116.4205	112.0273	107.6341	103.2408	98.8476	98.8476	103.2408	107.6341	112.0273	116.4205	120.8138	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy conte	179.1633	156.6974	161.6977	140.9719	135.2659	116.7242	108.1621	124.1176	125.6000	146.3747	159.7794	173.5101	(45)
Energy content (annual)										Total = Sum(45)m =		1728.0644	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.8745	23.5046	24.2546	21.1458	20.2899	17.5086	16.2243	18.6176	18.8400	21.9562	23.9669	26.0265	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
									Total per year (kWh/year) = Sum(64)m =			2337.0304	(64)
Heat gains from water heating, kWh/month													
	100.9481	89.4740	95.1408	86.9148	86.3522	78.8524	77.3402	82.6454	81.8036	90.0459	93.1683	99.0684	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	119.6162	106.2421	86.4019	65.4118	48.8961	41.2801	44.6046	57.9788	77.8190	98.8091	115.3248	122.9407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	135.6830	133.1459	127.8774	120.7150	116.0648	109.5172	103.9519	111.0826	113.6161	121.0294	129.4004	133.1565	(72)
Total internal gains													
	1107.9421	1099.6233	1055.3821	986.4986	913.9174	851.4306	816.9069	829.8193	871.3256	940.4599	1016.7619	1076.4573	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	11.9814	0.7200	0.7000	0.7700	76.9163	(74)
East	5.9900	22.3313	0.7200	0.7000	0.7700	46.7202	(76)
South	14.8400	50.9848	0.7200	0.7000	0.7700	264.2644	(78)
West	4.2500	22.3313	0.7200	0.7000	0.7700	33.1487	(80)

Solar gains	421.0496	662.3946	942.4501	1288.5368	1483.5446	1612.8363	1523.0330	1367.3103	1135.9395	795.1500	520.1207	354.7292	(83)
Total gains	1528.9917	1762.0179	1997.8321	2275.0354	2397.4620	2464.2669	2339.9399	2197.1296	2007.2650	1735.6099	1536.8826	1431.1865	(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	31.4077	31.4935	31.4935	31.6152	31.6152	31.7640	31.7283	31.7987	31.7640	31.6915	31.6915	31.5756	
alpha	3.0938	3.0996	3.0996	3.1077	3.1077	3.1176	3.1152	3.1199	3.1176	3.1128	3.1128	3.1050	
util living area													
	0.9856	0.9771	0.9566	0.9052	0.8009	0.6007	0.4265	0.4622	0.7474	0.9247	0.9750	0.9880	(86)
Tweekday	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
Tweekend	19.9749	20.0730	20.2715	20.5219	20.7479	20.8929	20.9320	20.9286	20.8309	20.5538	20.2254	19.9574	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	9	
24 / 9	22	2	0	0	0	0	0	0	0	0	0	22	
16 / 9	0	18	15	0	0	0	0	0	0	0	0	0	
MIT	21.0000	20.1392	20.1455	20.2535	20.6109	20.8355	20.8950	20.8898	20.7359	20.3113	19.7905	21.0000	(87)
Th 2	20.0814	20.0837	20.0837	20.0869	20.0869	20.0908	20.0898	20.0917	20.0908	20.0889	20.0889	20.0858	(88)
util rest of house													
	0.9831	0.9731	0.9485	0.8862	0.7573	0.5155	0.3100	0.3426	0.6786	0.9055	0.9698	0.9859	(89)
Tweekday	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
Tweekend	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
MIT 2	20.0814	18.2921	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	20.0858	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	20.2193	18.5694	18.8311	19.3185	19.7778	20.0427	20.0964	20.0948	19.9426	19.3943	18.6960	20.2231	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2193	18.5694	18.8311	19.3185	19.7778	20.0427	20.0964	20.0948	19.9426	19.3943	18.6960	20.2231	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9643	0.9340	0.8665	0.7402	0.5106	0.3109	0.3431	0.6657	0.8866	0.9587	0.9863	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Useful gains	1503.8270	1699.0669	1866.0261	1971.3982	1774.5670	1258.3050	727.5576	753.7897	1336.2192	1538.8389	1473.4257	1411.5130	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	5158.5920	4413.0101	3889.5610	3192.4088	2297.3570	1363.8493	741.8260	773.3348	1599.9781	2635.5361	3616.6951	5132.4424	(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	2719.1452	1823.7698	1505.5099	879.1276	388.9558	0.0000	0.0000	0.0000	0.0000	815.9427	1543.1539	2768.3715	(98)
Space heating												12443.9765	(98)
Space heating per m2											(98) / (4) =	36.5569	(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 %)												296.1528	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4201.8769	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2719.1452	1823.7698	1505.5099	879.1276	388.9558	0.0000	0.0000	0.0000	0.0000	815.9427	1543.1539	2768.3715	(98)
Space heating efficiency (main heating system 1)	296.1528	296.1528	296.1528	296.1528	296.1528	0.0000	0.0000	0.0000	0.0000	296.1528	296.1528	296.1528	(210)
Space heating fuel (main heating system)	918.1561	615.8205	508.3558	296.8493	131.3362	0.0000	0.0000	0.0000	0.0000	275.5141	521.0668	934.7781	(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	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	84.4166	74.3725	78.0308	69.8429	68.3667	60.9774	58.4569	64.2906	64.2226	72.4283	76.7194	82.3497	(219)
Water heating fuel used												854.4745	(219)
Annual totals kWh/year													
Space heating fuel - main system												4201.8769	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												844.9840	(232)
Total delivered energy for all uses												5901.3354	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	4201.8769	42.0240	1765.7968	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	598.1321	49.5400	296.3147	(245)
Low-rate cost	256.3423	11.9600	30.6585	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	844.9840	45.7820	386.8506	(250)
Additional standing charges			0.0000	(251)
Total energy cost			2479.6205	(255)

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	4201.8769	0.5190	2180.7741	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	854.4745	0.5190	443.4722	(264)
Space and water heating			2624.2464	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	844.9840	0.5190	438.5467	(268)
Total kg/year			3062.7931	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4201.8769	3.0700	12899.7622	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	854.4745	3.0700	2623.2366	(264)
Space and water heating			15522.9988	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	844.9840	3.0700	2594.1008	(268)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Primary energy kWh/year 18117.0996 (272)
Primary energy kWh/m2/year 53.2230 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86
Current environmental impact rating: B 88

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 3.6	-£ 752	-947 kg (30.9%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.6	-£ 115	-161 kg (5.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£752	2.78 kg/m²	B 90	B 91
Total Savings	£752	2.78 kg/m²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£2480	£2480	£0
Space heating	£1766	£1766	£0
Water heating	£327	£327	£0
Lighting	£387	£387	£0
Generated (PV)	-£0	-£752	£752
Total cost of fuels	£2480	£1728	£752
Total cost of uses	£2480	£1728	£752
Delivered energy	17 kWh/m²	12 kWh/m²	5 kWh/m²
Carbon dioxide emissions	3.1 tonnes	2.1 tonnes	0.9 tonnes
CO2 emissions per m²	9 kg/m²	6 kg/m²	3 kg/m²
Primary energy	53 kWh/m²	37 kWh/m²	16 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.9300	(2b) =	498.6860	(1b) - (3b)
First floor	170.2000	(1c)	x 2.4000	(2c) =	408.4800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		907.1660	(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							6 * 10 =		60.0000	(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) =		60.0000 / (5) =	0.0661	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2661	(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) =	0.2462	(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	0.3139	0.3077	0.3016	0.2708	0.2646	0.2339	0.2339	0.2277	0.2462	0.2646	0.2770	0.2893	(22b)
Effective ac	0.5493	0.5473	0.5455	0.5367	0.5350	0.5273	0.5273	0.5259	0.5303	0.5350	0.5384	0.5418	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	222.7700	55.3000	167.4700	0.1900	31.8193	60.0000	10048.2000	(29a)
External Wall 2	80.4500	18.3800	62.0700	0.1900	11.7933	190.0000	11793.3000	(29a)
External Roof 1	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			620.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		161.6448			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			18.0000	3063.6000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 38577.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	113.3308	(35)
Thermal bridges (User defined value 0.032 * total exposed area)	19.8637	(36)
Total fabric heat loss	(33) + (36) = 181.5084	(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	164.4291	163.8565	163.2952	160.6588	160.1655	157.8693	157.8693	157.4441	158.7538	160.1655	161.1634	162.2066	(38)
Heat transfer coeff	345.9375	345.3649	344.8036	342.1672	341.6740	339.3778	339.3778	338.9526	340.2622	341.6740	342.6718	343.7150	(39)
Average = Sum(39)m / 12 =												342.1649	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0163	1.0146	1.0129	1.0052	1.0037	0.9970	0.9970	0.9957	0.9996	1.0037	1.0067	1.0097	(40)
HLP (average)												1.0052	(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	3.1845 (42)
Average daily hot water use (litres/day)	109.8307 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.8138	116.4205	112.0273	107.6341	103.2408	98.8476	98.8476	103.2408	107.6341	112.0273	116.4205	120.8138	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	179.1633	156.6974	161.6977	140.9719	135.2659	116.7242	108.1621	124.1176	125.6000	146.3747	159.7794	173.5101	(45)
Energy content (annual)										Total = Sum(45)m =		1728.0644	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.8745	23.5046	24.2546	21.1458	20.2899	17.5086	16.2243	18.6176	18.8400	21.9562	23.9669	26.0265	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
									Total per year (kWh/year) = Sum(64)m =			2337.0304	(64)
Heat gains from water heating, kWh/month													
	100.9481	89.4740	95.1408	86.9148	86.3522	78.8524	77.3402	82.6454	81.8036	90.0459	93.1683	99.0684	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	119.6162	106.2421	86.4019	65.4118	48.8961	41.2801	44.6046	57.9788	77.8190	98.8091	115.3248	122.9407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	135.6830	133.1459	127.8774	120.7150	116.0648	109.5172	103.9519	111.0826	113.6161	121.0294	129.4004	133.1565	(72)
Total internal gains													
	1107.9421	1099.6233	1055.3821	986.4986	913.9174	851.4306	816.9069	829.8193	871.3256	940.4599	1016.7619	1076.4573	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1488.7739	1764.3550	2008.8895	2243.9699	2393.4444	2351.9557	2250.3496	2092.4597	1929.1347	1686.8561	1475.7966	1400.5208	(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	30.9769	31.0282	31.0787	31.3182	31.3634	31.5756	31.5756	31.6152	31.4935	31.3634	31.2721	31.1772	
alpha	3.0651	3.0685	3.0719	3.0879	3.0909	3.1050	3.1050	3.1077	3.0996	3.0909	3.0848	3.0785	
util living area													
	0.9883	0.9796	0.9627	0.9247	0.8502	0.7255	0.5868	0.6366	0.8246	0.9449	0.9813	0.9903	(86)
Tweekday	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
Tweekend	19.8834	19.9996	20.1880	20.4334	20.6613	20.8286	20.9012	20.8877	20.7565	20.4593	20.1250	19.8612	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	9	
24 / 9	22	3	0	0	0	0	0	0	0	0	0	22	
16 / 9	0	17	17	0	0	0	0	0	0	0	0	0	
MIT	21.0000	20.1068	20.0877	20.1153	20.4772	20.7367	20.8475	20.8267	20.6197	20.1656	19.6337	21.0000	(87)
Th 2	20.0698	20.0712	20.0726	20.0790	20.0802	20.0858	20.0858	20.0869	20.0837	20.0802	20.0778	20.0752	(88)
util rest of house													
	0.9864	0.9762	0.9561	0.9102	0.8185	0.6621	0.4892	0.5421	0.7761	0.9315	0.9775	0.9887	(89)
Tweekday	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
Tweekend	17.7179	17.9802	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	17.6715	
MIT 2	20.0698	18.2043	18.4039	18.9536	19.4463	19.7880	19.9128	19.8952	19.6543	19.0186	18.2691	20.0752	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	20.2095	18.4899	18.6567	19.1280	19.6011	19.9304	20.0531	20.0351	19.7992	19.1908	18.4740	20.2141	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2095	18.4899	18.6567	19.1280	19.6011	19.9304	20.0531	20.0351	19.7992	19.1908	18.4740	20.2141	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9867	0.9684	0.9428	0.8914	0.7990	0.6500	0.4854	0.5362	0.7580	0.9144	0.9683	0.9889	(94)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	1468.9340	1708.6156	1893.9132	2000.2317	1912.2754	1528.7396	1092.3886	1121.9105	1462.3628	1542.3887	1429.0657	1385.0138	(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													
	5503.6813	4693.4793	4191.6691	3499.6846	2699.6032	1809.0290	1171.9159	1232.1261	1939.2271	2935.2641	3897.5433	5504.2793	(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													
	3001.8520	2005.8284	1709.5304	1079.6061	585.7719	0.0000	0.0000	0.0000	0.0000	1036.2992	1777.3038	3064.7336	(98)
Space heating												14260.9255	(98)
Space heating per m2											(98) / (4) =	41.8946	(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 %)												295.9702	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4818.3649	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3001.8520	2005.8284	1709.5304	1079.6061	585.7719	0.0000	0.0000	0.0000	0.0000	1036.2992	1777.3038	3064.7336	(98)
Space heating efficiency (main heating system 1)													
	295.9702	295.9702	295.9702	295.9702	295.9702	0.0000	0.0000	0.0000	0.0000	295.9702	295.9702	295.9702	(210)
Space heating fuel (main heating system)													
	1014.2412	677.7129	577.6021	364.7685	197.9158	0.0000	0.0000	0.0000	0.0000	350.1363	600.5009	1035.4871	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month													
	84.4166	74.3725	78.0308	69.8429	68.3667	60.9774	58.4569	64.2906	64.2226	72.4283	76.7194	82.3497	(219)
Water heating fuel used												854.4745	(219)
Annual totals kWh/year													
Space heating fuel - main system												4818.3649	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												844.9840	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4790.5839	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*15.29 + 0.20*5.50)	4818.3649	13.3320	642.3844	(240)
Space heating - secondary (1.00*15.29 + 0.00*5.50)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	598.1321	15.2900	91.4544	(245)
Low-rate cost	256.3423	5.5000	14.0988	(246)
Pumps and fans for heating (0.90*15.29 + 0.10*5.50)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*15.29 + 0.10*5.50)	844.9840	14.3110	120.9257	(250)
Additional standing charges			24.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	13.7505	-237.5041	(252)
Total energy cost			655.3592	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7142	(257)
SAP value		90.0370	
SAP rating (Section 12)		90	(258)
SAP band		B	

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	4818.3649	0.5190	2500.7314	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	854.4745	0.5190	443.4722	(264)
Space and water heating			2944.2036	(265)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	0.0000	0.0000	0.0000 (267)
Energy for lighting	844.9840	0.5190	438.5467 (268)
Energy saving/generation technologies			
PV Unit (0.90*49.54 + 0.10*11.96)	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			2486.3131 (272)
CO2 emissions per m2			7.3000 (273)
EI value			91.3553
EI rating			91 (274)
EI band			B

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.9300 (2b)	=	498.6860	(1b) - (3b)
First floor	170.2000 (1c)	x	2.4000 (2c)	=	408.4800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	907.1660	(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							6 * 10	=	60.0000	(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) =	60.0000	/ (5) =	0.0661	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.2661	(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) =		0.2462	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2585	0.2462	0.2462	0.2277	0.2277	0.2031	0.2093	0.1969	0.2031	0.2154	0.2154	0.2339	(22b)
Effective ac	0.5334	0.5303	0.5303	0.5259	0.5259	0.5206	0.5219	0.5194	0.5206	0.5232	0.5232	0.5273	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			135.2800	0.1100	14.8808	0.0000	0.0000	(28a)
External Wall 1	222.7700	55.3000	167.4700	0.1900	31.8193	60.0000	10048.2000	(29a)
External Wall 2	80.4500	18.3800	62.0700	0.1900	11.7933	190.0000	11793.3000	(29a)
External Roof 1	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			620.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		161.6448			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			18.0000	3063.6000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	38577.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		113.3308	(35)
Thermal bridges (User defined value 0.032 * total exposed area)		19.8637	(36)
Total fabric heat loss	(33) + (36) =	181.5084	(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	159.6836	158.7538	158.7538	157.4441	157.4441	155.8566	156.2365	155.4881	155.8566	156.6277	156.6277	157.8693	(38)
Heat transfer coeff	341.1921	340.2622	340.2622	338.9526	338.9526	337.3651	337.7449	336.9965	337.3651	338.1361	338.1361	339.3778	(39)
Average = Sum(39)m / 12 =												338.7286	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0023	0.9996	0.9996	0.9957	0.9957	0.9911	0.9922	0.9900	0.9911	0.9933	0.9933	0.9970	(40)
HLP (average)												0.9951	(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	3.1845	(42)
Average daily hot water use (litres/day)	109.8307	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.8138	116.4205	112.0273	107.6341	103.2408	98.8476	98.8476	103.2408	107.6341	112.0273	116.4205	120.8138	(44)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	179.1633	156.6974	161.6977	140.9719	135.2659	116.7242	108.1621	124.1176	125.6000	146.3747	159.7794	173.5101	(45)
Energy content (annual)										Total = Sum(45)m =		1728.0644	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.8745	23.5046	24.2546	21.1458	20.2899	17.5086	16.2243	18.6176	18.8400	21.9562	23.9669	26.0265	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(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													
	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
									Total per year (kWh/year) = Sum(64)m =			2337.0304	(64)
Heat gains from water heating, kWh/month													
	100.9481	89.4740	95.1408	86.9148	86.3522	78.8524	77.3402	82.6454	81.8036	90.0459	93.1683	99.0684	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	119.6162	106.2421	86.4019	65.4118	48.8961	41.2801	44.6046	57.9788	77.8190	98.8091	115.3248	122.9407	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	135.6830	133.1459	127.8774	120.7150	116.0648	109.5172	103.9519	111.0826	113.6161	121.0294	129.4004	133.1565	(72)
Total internal gains													
	1107.9421	1099.6233	1055.3821	986.4986	913.9174	851.4306	816.9069	829.8193	871.3256	940.4599	1016.7619	1076.4573	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	11.9814	0.7200	0.7000	0.7700	76.9163	(74)
East	5.9900	22.3313	0.7200	0.7000	0.7700	46.7202	(76)
South	14.8400	50.9848	0.7200	0.7000	0.7700	264.2644	(78)
West	4.2500	22.3313	0.7200	0.7000	0.7700	33.1487	(80)

Solar gains	421.0496	662.3946	942.4501	1288.5368	1483.5446	1612.8363	1523.0330	1367.3103	1135.9395	795.1500	520.1207	354.7292	(83)
Total gains	1528.9917	1762.0179	1997.8321	2275.0354	2397.4620	2464.2669	2339.9399	2197.1296	2007.2650	1735.6099	1536.8826	1431.1865	(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	31.4077	31.4935	31.4935	31.6152	31.6152	31.7640	31.7283	31.7987	31.7640	31.6915	31.6915	31.5756	
alpha	3.0938	3.0996	3.0996	3.1077	3.1077	3.1176	3.1152	3.1199	3.1176	3.1128	3.1128	3.1050	
util living area													
	0.9856	0.9771	0.9566	0.9052	0.8009	0.6007	0.4265	0.4622	0.7474	0.9247	0.9750	0.9880	(86)
Tweekday	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
Tweekend	19.9749	20.0730	20.2715	20.5219	20.7479	20.8929	20.9320	20.9286	20.8309	20.5538	20.2254	19.9574	
24 / 16	9	0	0	0	0	0	0	0	0	0	0	9	
24 / 9	22	2	0	0	0	0	0	0	0	0	0	22	
16 / 9	0	18	15	0	0	0	0	0	0	0	0	0	
MIT	21.0000	20.1392	20.1455	20.2535	20.6109	20.8355	20.8950	20.8898	20.7359	20.3113	19.7905	21.0000	(87)
Th 2	20.0814	20.0837	20.0837	20.0869	20.0869	20.0908	20.0898	20.0917	20.0908	20.0889	20.0889	20.0858	(88)
util rest of house													
	0.9831	0.9731	0.9485	0.8862	0.7573	0.5155	0.3100	0.3426	0.6786	0.9055	0.9698	0.9859	(89)
Tweekday	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
Tweekend	17.9323	18.1543	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	17.8962	
MIT 2	20.0814	18.2921	18.5988	19.1533	19.6306	19.9026	19.9553	19.9543	19.8024	19.2323	18.5026	20.0858	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	20.2193	18.5694	18.8311	19.3185	19.7778	20.0427	20.0964	20.0948	19.9426	19.3943	18.6960	20.2231	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2193	18.5694	18.8311	19.3185	19.7778	20.0427	20.0964	20.0948	19.9426	19.3943	18.6960	20.2231	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9643	0.9340	0.8665	0.7402	0.5106	0.3109	0.3431	0.6657	0.8866	0.9587	0.9863	(94)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	1503.8270	1699.0669	1866.0261	1971.3982	1774.5670	1258.3050	727.5576	753.7897	1336.2192	1538.8389	1473.4257	1411.5130	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	5158.5920	4413.0101	3889.5610	3192.4088	2297.3570	1363.8493	741.8260	773.3348	1599.9781	2635.5361	3616.6951	5132.4424	(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	2719.1452	1823.7698	1505.5099	879.1276	388.9558	0.0000	0.0000	0.0000	0.0000	815.9427	1543.1539	2768.3715	(98)
Space heating												12443.9765	(98)
Space heating per m2											(98) / (4) =	36.5569	(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 %)												296.1528	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												4201.8769	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2719.1452	1823.7698	1505.5099	879.1276	388.9558	0.0000	0.0000	0.0000	0.0000	815.9427	1543.1539	2768.3715	(98)
Space heating efficiency (main heating system 1)	296.1528	296.1528	296.1528	296.1528	296.1528	0.0000	0.0000	0.0000	0.0000	296.1528	296.1528	296.1528	(210)
Space heating fuel (main heating system)	918.1561	615.8205	508.3558	296.8493	131.3362	0.0000	0.0000	0.0000	0.0000	275.5141	521.0668	934.7781	(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	230.8837	203.4126	213.4181	191.0239	186.9863	166.7762	159.8825	175.8380	175.6520	198.0951	209.8314	225.2305	(64)
Efficiency of water heater												273.5050	(216)
(217)m	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	273.5050	(217)
Fuel for water heating, kWh/month	84.4166	74.3725	78.0308	69.8429	68.3667	60.9774	58.4569	64.2906	64.2226	72.4283	76.7194	82.3497	(219)
Water heating fuel used												854.4745	(219)
Annual totals kWh/year													
Space heating fuel - main system												4201.8769	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												844.9840	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												4077.1757	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (0.80*49.54 + 0.20*11.96)	4201.8769	42.0240	1765.7968	(240)
Space heating - secondary (1.00*49.54 + 0.00*11.96)	0.0000	0.0000	0.0000	(242)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	598.1321	49.5400	296.3147	(245)
Low-rate cost	256.3423	11.9600	30.6585	(246)
Pumps and fans for heating (0.90*49.54 + 0.10*11.96)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*49.54 + 0.10*11.96)	844.9840	45.7820	386.8506	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	41.2510	-752.4841	(252)
Total energy cost			1727.1364	(255)

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	4201.8769	0.5190	2180.7741	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating	854.4745	0.5190	443.4722	(264)
Space and water heating			2624.2464	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	844.9840	0.5190	438.5467	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			2116.0542	(272)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4201.8769	3.0700	12899.7622	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating	854.4745	3.0700	2623.2366	(264)
Space and water heating			15522.9988	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	844.9840	3.0700	2594.1008	(268)
Energy saving/generation technologies				
PV Unit (0.90*49.54 + 0.10*11.96)	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			12516.9295	(272)
Primary energy kWh/m2/year			36.7712	(273)

APPENDIX B – SAP 2021

Full SAP Calculation Printout

Property Reference	P1 Oakley	**Issued on Date**	16/01/2024
Assessment Reference	P1 Oakley	**Prop Type Ref**	Detached
Property	1, Windsor		

SAP Rating	80 C	**DER**	3.38	**TER**	8.63
Environmental	96 A	**% DER < TER**			60.83
CO_2 Emissions (t/year)	0.93	**DFEE**	41.75	**TFEE**	43.70
Compliance Check	See BREL	**% DFEE < TFEE**			4.46
% DPER < TPER	23.85	**DPER**	34.88	**TPER**	45.81

Assessor Details	Mrs. Naomi Sadler	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne Homes		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.1077	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3077	(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) =	0.2846	(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	0.3629	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2846	0.3060	0.3202	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(25)

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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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			134.2700			18.0000	2416.8600	(32d)
Internal Ceiling 1			134.2700			9.0000	1208.4300	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		27991.4840	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							93.1094	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388	
E15 Flat roof with parapet	7.6810	0.3000	2.3043	
E16 Corner (normal)	30.5800	0.0570	1.7431	
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330	
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822	
E3 Sill	22.5200	0.0450	1.0134	
E4 Jamb	99.5600	0.0510	5.0776	
E5 Ground floor (normal)	49.3000	0.0640	3.1552	
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.5815 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 165.4955 (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	156.0070	155.3019	154.6109	151.3648	150.7575	147.9303	147.9303	147.4068	149.0193	150.7575	151.9861	153.2706	(38)
Heat transfer coeff	321.5025	320.7974	320.1063	316.8603	316.2530	313.4258	313.4258	312.9023	314.5148	316.2530	317.4816	318.7660	(39)

Average = Sum(39)m / 12 = 316.8574

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0694	1.0671	1.0648	1.0540	1.0520	1.0426	1.0426	1.0408	1.0462	1.0520	1.0561	1.0603	(40)
HLP (average)												1.0540	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1327 (42)

Hot water usage for mixer showers

105.5255	103.9396	101.6287	97.2073	93.9444	90.3056	88.2373	90.5307	93.0447	96.9516	101.4681	105.1212	(42a)

Hot water usage for baths

33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day) 170.4703 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.3644	181.5879	176.8856	169.4881	163.5700	157.1720	154.5308	159.2108	164.1725	170.9130	178.4318	184.8481	(44)
Energy conte	293.5719	258.5788	271.8666	232.0208	220.1967	193.2613	186.8917	197.1363	202.4411	231.9273	254.2088	289.4274	(45)

Energy content (annual) Total = Sum(45)m = 2831.5286

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

44.0358	38.7868	40.7800	34.8031	33.0295	28.9892	28.0337	29.5704	30.3662	34.7891	38.1313	43.4141	(46)

Water storage loss:

Store volume 400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.2000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1880 (55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
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)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Primary loss / Combi loss

Total heat required for water heating calculated for each month

353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)

Total per year (kWh/year) = Sum(64)m = 3539.0446 (64)

12Total per year (kWh/year) 3539 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

145.6850	129.3976	138.4680	123.6685	121.2877	110.7810	110.2138	113.6201	113.8333	125.1881	131.0460	144.3069	(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	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.5136	281.7829	254.5136	262.9974	254.5136	262.9974	254.5136	254.5136	262.9974	254.5136	262.9974	254.5136	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.7745	463.5351	451.5384	425.9990	393.7599	363.4598	343.2175	338.4568	350.4535	375.9930	408.2320	438.5321	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)	195.8131	192.5560	186.1129	171.7618	163.0211	153.8625	148.1368	152.7152	158.1018	168.2636	182.0083	193.9609	(72)
Total internal gains	979.0924	1007.8652	962.1561	930.7494	881.2859	850.3109	815.8591	815.6769	841.5439	868.7614	923.2289	956.9979	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1268.8732	1555.5586	1827.9402	2154.0716	2356.7071	2352.7272	2249.3089	2060.9858	1834.1336	1508.0991	1280.8306	1197.8306	(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	24.1846	24.2378	24.2901	24.5389	24.5861	24.8078	24.8078	24.8493	24.7219	24.5861	24.4909	24.3922	
alpha	2.6123	2.6159	2.6193	2.6359	2.6391	2.6539	2.6539	2.6566	2.6481	2.6391	2.6327	2.6261	
util living area	0.9823	0.9693	0.9453	0.8907	0.7999	0.6662	0.5353	0.5873	0.7838	0.9265	0.9724	0.9847	(86)
Living	18.6291	18.8821	19.2877	19.8308	20.3029	20.6425	20.7880	20.7583	20.4804	19.8431	19.1435	18.5930	
Non living	17.2009	17.5242	18.0399	18.7260	19.3015	19.6946	19.8389	19.8165	19.5247	18.7535	17.8658	17.1597	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.7872	18.8821	19.2877	19.8308	20.3029	20.6425	20.7880	20.7583	20.4804	19.8431	19.1435	18.9297	(87)
Th 2	20.0259	20.0278	20.0297	20.0386	20.0403	20.0480	20.0480	20.0495	20.0450	20.0403	20.0369	20.0334	(88)
util rest of house	0.9796	0.9648	0.9369	0.8728	0.7647	0.6026	0.4421	0.4959	0.7328	0.9110	0.9675	0.9824	(89)
MIT 2	18.8997	17.5242	18.0399	18.7260	19.3015	19.6946	19.8389	19.8165	19.5247	18.7535	17.8658	17.6775	(90)
Living area fraction										fLA = Living area / (4) =		0.2813	(91)
MIT	19.1494	17.9062	18.3909	19.0368	19.5832	19.9613	20.1059	20.0815	19.7936	19.0600	18.2253	18.0298	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1494	17.9062	18.3909	19.0368	19.5832	19.9613	20.1059	20.0815	19.7936	19.0600	18.2253	18.0298	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9768	0.9511	0.9181	0.8500	0.7453	0.5961	0.4483	0.4993	0.7171	0.8903	0.9548	0.9760	(94)
Useful gains	1239.3905	1479.5559	1678.2991	1830.9874	1756.3994	1402.5690	1008.2697	1028.9534	1315.3224	1342.6165	1222.8733	1169.0929	(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	4774.1051	4172.3617	3806.3610	3211.9568	2493.0944	1680.3544	1098.8495	1151.9436	1790.7147	2675.5081	3532.0696	4408.4697	(97)
Space heating kWh	2629.8276	1809.5655	1583.2781	994.2980	548.1011	0.0000	0.0000	0.0000	0.0000	991.6713	1662.6213	2410.0963	(98a)
Space heating requirement - total per year (kWh/year)												12629.4591	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2629.8276	1809.5655	1583.2781	994.2980	548.1011	0.0000	0.0000	0.0000	0.0000	991.6713	1662.6213	2410.0963	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12629.4591	
Space heating per m2											(98c) / (4) =	42.0100	(99)

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 %) 301.3337 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2629.8276	1809.5655	1583.2781	994.2980	548.1011	0.0000	0.0000	0.0000	0.0000	991.6713	1662.6213	2410.0963	(98)
Space heating efficiency (main heating system 1)	301.3337	301.3337	301.3337	301.3337	301.3337	0.0000	0.0000	0.0000	0.0000	301.3337	301.3337	301.3337	(210)
Space heating fuel (main heating system)	872.7293	600.5188	525.4235	329.9657	181.8917	0.0000	0.0000	0.0000	0.0000	329.0941	551.7542	799.8098	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
Efficiency of water heater												167.9573	(216)
(217)m	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	(217)
Fuel for water heating, kWh/month	210.5668	186.2700	197.6437	172.7658	166.8800	149.6889	147.0505	153.1501	155.1544	173.8643	185.9763	208.0993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	51.8020	41.5575	37.4179	27.4140	21.1753	17.3004	19.3168	25.1088	32.6138	42.7911	48.3324	53.2417	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	4191.1871	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.9573	
Water heating fuel used	2107.1102	(219)

Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.0718	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6716.3691	(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 (high-rate cost)	3352.9497	0.1623	544.2544	(261)
Space heating - main system 1 (low-rate cost)	838.2374	0.1363	114.2256	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1474.9771	0.1479	218.2212	(264)
Water heating - low rate cost	632.1331	0.1242	78.4920	(264)
Space and water heating			955.1933	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.0718	0.1490	62.3010	(268)
Total CO2, kg/year			1017.4942	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	3352.9497	1.2842	5382.2725	(275)
Space heating - main system 1 (low-rate cost)	838.2374	1.4929	1251.4357	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1474.9771	1.5530	2290.6859	(278)
Water heating - low rate cost	632.1331	1.4444	913.0344	(278)
Space and water heating			9837.4285	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	418.0718	1.5547	649.9948	(282)
Total Primary energy kWh/year			10487.4233	(286)
Dwelling Primary energy Rate (DPER)			34.8800	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0479 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2979 (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) =	0.2755 (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	0.3513	0.3444	0.3375	0.3031	0.2962	0.2618	0.2618	0.2549	0.2755	0.2962	0.3100	0.3238	(22b)
Effective ac	0.5617	0.5593	0.5570	0.5459	0.5439	0.5343	0.5343	0.5325	0.5380	0.5439	0.5480	0.5524	(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 Semi-glazed door			18.8700	1.0000	18.8700			(26a)
TER Opening Type (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1300	21.6255			(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1800	36.2326			(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1800	5.4666			(29a)
External Roof 1	14.1600		14.1600	0.1100	1.5576			(30)
External Roof 3	152.2300		152.2300	0.1100	16.7453			(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	143.5396			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 93.1094 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	60.1370	0.0600	3.6082
E15 Flat roof with parapet	7.6810	0.5600	4.3014
E16 Corner (normal)	30.5800	0.0900	2.7522
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0900	-0.7641
E2 Other lintels (including other steel lintels)	30.8800	0.0500	1.5440
E3 Sill	22.5200	0.0500	1.1260
E4 Jamb	99.5600	0.0500	4.9780
E5 Ground floor (normal)	49.3000	0.1600	7.8880
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4337 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 168.9733 (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	154.8635	154.2029	153.5553	150.5137	149.9446	147.2955	147.2955	146.8049	148.3159	149.9446	151.0959	152.2994	(38)
Heat transfer coeff	323.8368	323.1762	322.5286	319.4870	318.9179	316.2688	316.2688	315.7782	317.2892	318.9179	320.0692	321.2727	(39)
Average = Sum(39)m / 12 =												319.4843	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0772	1.0750	1.0728	1.0627	1.0608	1.0520	1.0520	1.0504	1.0554	1.0608	1.0647	1.0687	(40)
HLP (average)												1.0627	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1327 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
76.7458	75.5925	73.9118	70.6962	68.3232	65.6768	64.1726	65.8405	67.6689	70.5103	73.7949	76.4518	(42a)

Hot water usage for baths

33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day) 143.9364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	156.5847	153.2408	149.1687	142.9770	137.9489	132.5432	130.4661	134.5206	138.7967	144.4716	150.7587	156.1787	(44)
Energy conte	247.9919	218.2128	229.2667	195.7284	185.7057	162.9774	157.7875	166.5646	171.1502	196.0466	214.7833	244.5381	(45)
Energy content (annual)										Total = Sum(45)m =		2390.7532	
Distribution loss (46)m = 0.15 x (45)m	37.1988	32.7319	34.3900	29.3593	27.8559	24.4466	23.6681	24.9847	25.6725	29.4070	32.2175	36.6807	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.5234	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.3626	(55)
Total storage loss	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(56)
If cylinder contains dedicated solar storage	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	313.4960	277.3778	294.7708	259.1195	251.2098	226.3684	223.2916	232.0688	234.5413	261.5508	278.1744	310.0422	(62)
WWHRS	-35.0850	-31.0294	-32.4922	-26.9049	-25.0744	-21.4563	-20.1119	-21.3870	-22.1995	-26.1708	-29.6483	-34.4353	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	278.4110	246.3484	262.2786	232.2146	226.1354	204.9121	203.1797	210.6818	212.3417	235.3800	248.5261	275.6069	(64)
									Total per year (kWh/year) = Sum(64)m =			2836.0164	(64)
12Total per year (kWh/year)												2836	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	134.8606	119.8878	128.6345	115.7926	114.1504	104.9028	104.8676	107.7860	107.6203	117.5888	122.1283	133.7122	(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	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.5136	281.7829	254.5136	262.9974	254.5136	262.9974	254.5136	254.5136	262.9974	254.5136	262.9974	254.5136	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	458.7745	463.5351	451.5384	425.9990	393.7599	363.4598	343.2175	338.4568	350.4535	375.9930	408.2320	438.5321	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													

	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)												
	181.2643	178.4044	172.8958	160.8230	153.4280	145.6984	140.9511	144.8737	149.4726	158.0495	169.6227	179.7207 (72)
Total internal gains												
	967.5435	996.7136	951.9390	922.8106	874.6928	842.1468	808.6734	807.8353	832.9147	861.5473	913.8433	945.7576 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.6300	0.7000	0.7700	2.8272	(74)
East	12.2400	19.6403	0.6300	0.7000	0.7700	73.4684	(76)
South	3.6600	46.7521	0.6300	0.7000	0.7700	52.2942	(78)
West	20.8200	19.6403	0.6300	0.7000	0.7700	124.9683	(80)

Solar gains	253.5582	479.2317	757.5611	1070.4070	1290.9936	1314.6143	1254.2686	1089.6453	868.5160	559.4205	312.9015	210.7286	(83)
Total gains	1221.1017	1475.9454	1709.5001	1993.2175	2165.6863	2156.7611	2062.9420	1897.4807	1701.4308	1420.9678	1226.7447	1156.4863	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.0103	24.0594	24.1077	24.3372	24.3806	24.5848	24.5848	24.6230	24.5058	24.3806	24.2929	24.2019	
alpha	2.6007	2.6040	2.6072	2.6225	2.6254	2.6390	2.6390	2.6415	2.6337	2.6254	2.6195	2.6135	
util living area													
	0.9838	0.9728	0.9527	0.9062	0.8263	0.7018	0.5725	0.6231	0.8088	0.9353	0.9750	0.9859	(86)
MIT	17.9426	18.2597	18.7812	19.4951	20.1397	20.6255	20.8456	20.8016	20.4042	19.5465	18.6248	17.8962	(87)
Th 2	20.0195	20.0213	20.0231	20.0314	20.0329	20.0402	20.0402	20.0416	20.0374	20.0329	20.0298	20.0265	(88)
util rest of house													
	0.9813	0.9687	0.9452	0.8902	0.7936	0.6392	0.4764	0.5302	0.7606	0.9212	0.9705	0.9838	(89)
MIT 2	16.3897	16.7946	17.4583	18.3606	19.1519	19.7183	19.9411	19.9060	19.4829	18.4384	17.2678	16.3340	(90)
Living area fraction										fLA = Living area / (4) =		0.2813	(91)
MIT	16.8266	17.2068	17.8305	18.6798	19.4298	19.9735	20.1956	20.1580	19.7421	18.7502	17.6496	16.7735	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8266	17.2068	17.8305	18.6798	19.4298	19.9735	20.1956	20.1580	19.7421	18.7502	17.6496	16.7735	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9688	0.9510	0.9215	0.8614	0.7693	0.6343	0.4932	0.5426	0.7430	0.8954	0.9539	0.9725	(94)
Useful gains	1182.9950	1403.6711	1575.3194	1717.0073	1665.9755	1368.1264	1017.4799	1029.5877	1264.0978	1272.3628	1170.2411	1124.7313	(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													
	4056.5638	3977.2694	3654.4175	3124.5257	2465.1877	1699.4798	1137.1626	1186.6851	1790.1821	2599.2364	3376.6059	4039.5301	(97)
Space heating kWh													
	2137.9352	1729.4581	1546.8490	1013.4132	594.6138	0.0000	0.0000	0.0000	0.0000	987.1940	1588.5826	2168.6103	(98a)
Space heating requirement - total per year (kWh/year)												11766.6562	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2137.9352	1729.4581	1546.8490	1013.4132	594.6138	0.0000	0.0000	0.0000	0.0000	987.1940	1588.5826	2168.6103	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11766.6562	
Space heating per m2											(98c) / (4) =	39.1400	(99)

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 %)	92.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2137.9352	1729.4581	1546.8490	1013.4132	594.6138	0.0000	0.0000	0.0000	0.0000	987.1940	1588.5826	2168.6103	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	2316.2894	1873.7357	1675.8927	1097.9558	644.2187	0.0000	0.0000	0.0000	0.0000	1069.5493	1721.1079	2349.5236	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	278.4110	246.3484	262.2786	232.2146	226.1354	204.9121	203.1797	210.6818	212.3417	235.3800	248.5261	275.6069	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6609	87.5686	87.3714	86.9714	86.1238	79.8000	79.8000	79.8000	79.8000	86.9128	87.4655	87.6849	(217)
Fuel for water heating, kWh/month													
	317.6001	281.3204	300.1880	267.0011	262.5702	256.7821	254.6112	264.0123	266.0924	270.8231	284.1418	314.3152	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	52.8829	42.4246	38.1987	27.9860	21.6172	17.6614	19.7199	25.6327	33.2943	43.6840	49.3409	54.3527	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-109.3698	-146.5425	-200.1261	-213.1553	-219.9770	-201.4886	-198.6032	-191.9850	-179.3618	-161.3730	-117.3144	-95.4430	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													

(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-87.2280	-179.8739	-351.2390	-518.8888	-678.2013	-678.9644	-671.3171	-572.2504	-424.3946	-254.6863	-115.5576	-69.2902	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	12748.2733	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3339.4580	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	426.7953	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6636.6312	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	9963.8954	(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	12748.2733	0.2100	2677.1374	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3339.4580	0.2100	701.2862	(264)
Space and water heating			3378.4236	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	426.7953	0.1443	61.5997	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2034.7397	0.1358	-276.2380	
PV Unit electricity exported	-4601.8915	0.1264	-581.5777	
Total			-857.8157	(269)
Total CO2, kg/year			2594.1369	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.6300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	12748.2733	1.1300	14405.5488	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3339.4580	1.1300	3773.5875	(278)
Space and water heating			18179.1363	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	426.7953	1.5338	654.6328	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2034.7397	1.5018	-3055.8007	
PV Unit electricity exported	-4601.8915	0.4639	-2134.8840	
Total			-5190.6847	(283)
Total Primary energy kWh/year			13773.1853	(286)
Target Primary Energy Rate (TPER)			45.8100	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 300.6300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)

Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0479	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2479	(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) =	0.2293	(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	0.2923	0.2866	0.2809	0.2522	0.2465	0.2178	0.2178	0.2121	0.2293	0.2465	0.2579	0.2694	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5427	0.5411	0.5394	0.5318	0.5304	0.5237	0.5237	0.5225	0.5263	0.5304	0.5333	0.5363	(25)

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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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			134.2700			18.0000	2416.8600	(32d)
Internal Ceiling 1			134.2700			9.0000	1208.4300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27991.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		93.1094 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388
E15 Flat roof with parapet	7.6810	0.3000	2.3043
E16 Corner (normal)	30.5800	0.0570	1.7431
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822
E3 Sill	22.5200	0.0450	1.0134
E4 Jamb	99.5600	0.0510	5.0776
E5 Ground floor (normal)	49.3000	0.0640	3.1552
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		22.5815 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	165.4955 (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	149.6314	149.1739	148.7255	146.6193	146.2252	144.3908	144.3908	144.0511	145.0974	146.2252	147.0224	147.8558	(38)
Heat transfer coeff	315.1268	314.6694	314.2210	312.1148	311.7207	309.8863	309.8863	309.5465	310.5929	311.7207	312.5179	313.3513	(39)
Average = Sum(39)m / 12 =												312.1129	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0482	1.0467	1.0452	1.0382	1.0369	1.0308	1.0308	1.0297	1.0331	1.0369	1.0395	1.0423	(40)
HLP (average)												1.0382	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1327 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day)		73.1793 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	79.8389	77.6483	75.2569	72.2808	69.6257	66.8664	66.2935	68.6801	71.1278	73.9614	76.9637	79.7269	(44)
Energy conte	126.4453	110.5701	115.6670	98.9488	93.7296	82.2201	80.1763	85.0404	87.7077	100.3649	109.6489	124.8331	(45)
Energy content (annual)										Total = Sum(45)m =		1215.3521	

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

107.4785	93.9846	98.3169	84.1065	79.6701	69.8871	68.1499	72.2843	74.5516	85.3101	93.2016	106.1081	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)

FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	107.4785	93.9846	98.3169	84.1065	79.6701	69.8871	68.1499	72.2843	74.5516	85.3101	93.2016	106.1081	(64)
											Total per year (kWh/year) = Sum(64)m =	1033.0493	(64)
12Total per year (kWh/year)												1033	(64)
Electric shower(s)													
	61.4606	54.7619	59.7979	57.0644	58.1352	55.4553	57.3038	58.1352	57.0644	59.7979	58.6735	61.4606	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	699.1107	(64a)
Heat gains from water heating, kWh/month													
	42.2348	37.1866	39.5287	35.2927	34.4513	31.3356	31.3634	32.6049	32.9040	36.2770	37.9688	41.8922	(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	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	254.5136	281.7829	254.5136	262.9974	254.5136	262.9974	254.5136	254.5136	262.9974	254.5136	262.9974	254.5136	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	458.7745	463.5351	451.5384	425.9990	393.7599	363.4598	343.2175	338.4568	350.4535	375.9930	408.2320	438.5321	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)													
	56.7672	55.3372	53.1300	49.0177	46.3055	43.5217	42.1551	43.8238	45.7000	48.7594	52.7344	56.3067	(72)
Total internal gains													
	840.0464	870.6465	829.1732	808.0052	764.5703	739.9701	709.8774	706.7854	729.1421	749.2572	793.9550	819.3436	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1129.8272	1418.3399	1694.9573	2031.3275	2239.9915	2242.3864	2143.3272	1952.0944	1721.7319	1388.5949	1151.5567	1060.1763	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.6739	24.7098	24.7450	24.9120	24.9435	25.0912	25.0912	25.1187	25.0341	24.9435	24.8799	24.8137	
alpha	2.6449	2.6473	2.6497	2.6608	2.6629	2.6727	2.6727	2.6746	2.6689	2.6629	2.6587	2.6542	
util living area													
	0.9865	0.9750	0.9530	0.9010	0.8128	0.6817	0.5509	0.6058	0.8015	0.9374	0.9783	0.9886	(86)
MIT	17.9526	18.2924	18.8370	19.5647	20.2044	20.6637	20.8648	20.8214	20.4361	19.5685	18.6285	17.8956	(87)
Th 2	20.0433	20.0446	20.0458	20.0516	20.0527	20.0578	20.0578	20.0587	20.0558	20.0527	20.0505	20.0482	(88)
util rest of house													
	0.9845	0.9713	0.9456	0.8846	0.7792	0.6190	0.4574	0.5145	0.7530	0.9238	0.9744	0.9869	(89)
MIT 2	17.2157	17.5541	18.0941	18.8099	19.4194	19.8335	19.9904	19.9639	19.6469	18.8252	17.8945	17.1621	(90)
Living area fraction											fLA = Living area / (4) =	0.2813	(91)
MIT	17.4230	17.7618	18.3031	19.0223	19.6402	20.0671	20.2364	20.2051	19.8690	19.0343	18.1010	17.3684	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4230	17.7618	18.3031	19.0223	19.6402	20.0671	20.2364	20.2051	19.8690	19.0343	18.1010	17.3684	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9763	0.9586	0.9277	0.8625	0.7622	0.6197	0.4764	0.5299	0.7418	0.9046	0.9630	0.9797	(94)
Useful gains	1103.0454	1359.6650	1572.3441	1751.9293	1707.3154	1389.6245	1021.0312	1034.5025	1277.1542	1256.1045	1108.9737	1038.6514	(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													
	4135.4126	4047.2270	3708.7848	3159.3163	2475.1345	1694.1826	1126.8618	1177.8599	1791.8005	2629.1439	3437.9997	4126.3452	(97)
Space heating kWh													
	2256.0812	1806.0417	1589.5118	1013.3186	571.2574	0.0000	0.0000	0.0000	0.0000	1021.5413	1676.8987	2297.2442	(98a)
Space heating requirement - total per year (kWh/year)												12231.8950	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2256.0812	1806.0417	1589.5118	1013.3186	571.2574	0.0000	0.0000	0.0000	0.0000	1021.5413	1676.8987	2297.2442	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12231.8950	
Space heating per m2											(98c) / (4) =	40.6875	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2912.9308	2293.1583	2352.5537	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6675	0.7401	0.6953	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1944.4597	1697.2456	1635.6965	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2483.9232	2373.5274	2155.4005	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													

	0.0000	0.0000	0.0000	0.0000	0.0000	388.4137	503.1537	386.6598	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	97.1034	125.7884	96.6650	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												319.5568 (107)
Energy for space heating												40.6875 (99)
Energy for space cooling												1.0630 (108)
Total												41.7505 (109)
Fabric Energy Efficiency (DFEE)												41.8 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0479	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2979	(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) =	0.2755	(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													
	0.3513	0.3444	0.3375	0.3031	0.2962	0.2618	0.2618	0.2549	0.2755	0.2962	0.3100	0.3238	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5617	0.5593	0.5570	0.5459	0.5439	0.5343	0.5343	0.5325	0.5380	0.5439	0.5480	0.5524	(25)

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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 Semi-glazed door			18.8700	1.0000	18.8700			(26a)
TER Opening Type (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1300	21.6255			(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1800	36.2326			(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1800	5.4666			(29a)
External Roof 1	14.1600		14.1600	0.1100	1.5576			(30)
External Roof 3	152.2300		152.2300	0.1100	16.7453			(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	143.5396			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			93.1094 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	60.1370	0.0600	3.6082
E15 Flat roof with parapet	7.6810	0.5600	4.3014
E16 Corner (normal)	30.5800	0.0900	2.7522
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0900	-0.7641
E2 Other lintels (including other steel lintels)	30.8800	0.0500	1.5440
E3 Sill	22.5200	0.0500	1.1260
E4 Jamb	99.5600	0.0500	4.9780
E5 Ground floor (normal)	49.3000	0.1600	7.8880
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			25.4337 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =		168.9733 (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	154.8635	154.2029	153.5553	150.5137	149.9446	147.2955	147.2955	146.8049	148.3159	149.9446	151.0959	152.2994	(38)

Heat transfer coeff

	323.8368	323.1762	322.5286	319.4870	318.9179	316.2688	316.2688	315.7782	317.2892	318.9179	320.0692	321.2727 (39)
Average = Sum(39)m / 12 =												319.4843

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0772	1.0750	1.0728	1.0627	1.0608	1.0520	1.0520	1.0504	1.0554	1.0608	1.0647	1.0687	(40)
HLP (average)												1.0627	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.1327	(42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)
Hot water usage for other uses													
	46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)
Average daily hot water use (litres/day)												73.1793	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	79.8389	77.6483	75.2569	72.2808	69.6257	66.8664	66.2935	68.6801	71.1278	73.9614	76.9637	79.7269	(44)
Energy conte	126.4453	110.5701	115.6670	98.9488	93.7296	82.2201	80.1763	85.0404	87.7077	100.3649	109.6489	124.8331	(45)
Energy content (annual)											Total = Sum(45)m =	1215.3521	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	107.4785	93.9846	98.3169	84.1065	79.6701	69.8871	68.1499	72.2843	74.5516	85.3101	93.2016	106.1081	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	107.4785	93.9846	98.3169	84.1065	79.6701	69.8871	68.1499	72.2843	74.5516	85.3101	93.2016	106.1081	(64)
											Total per year (kWh/year) = Sum(64)m =	1033.0493	(64)
12Total per year (kWh/year)												1033	(64)
Electric shower(s)													
	61.4606	54.7619	59.7979	57.0644	58.1352	55.4553	57.3038	58.1352	57.0644	59.7979	58.6735	61.4606	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												699.1107	(64a)
Heat gains from water heating, kWh/month													
	42.2348	37.1866	39.5287	35.2927	34.4513	31.3356	31.3634	32.6049	32.9040	36.2770	37.9688	41.8922	(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	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	156.6374	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	254.5136	281.7829	254.5136	262.9974	254.5136	262.9974	254.5136	254.5136	262.9974	254.5136	262.9974	254.5136	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	458.7745	463.5351	451.5384	425.9990	393.7599	363.4598	343.2175	338.4568	350.4535	375.9930	408.2320	438.5321	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	38.6637	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)													
	56.7672	55.3372	53.1300	49.0177	46.3055	43.5217	42.1551	43.8238	45.7000	48.7594	52.7344	56.3067	(72)
Total internal gains													
	840.0464	870.6465	829.1732	808.0052	764.5703	739.9701	709.8774	706.7854	729.1421	749.2572	793.9550	819.3436	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.6300	0.7000	0.7700	2.8272	(74)
East	12.2400	19.6403	0.6300	0.7000	0.7700	73.4684	(76)
South	3.6600	46.7521	0.6300	0.7000	0.7700	52.2942	(78)
West	20.8200	19.6403	0.6300	0.7000	0.7700	124.9683	(80)

Solar gains	253.5582	479.2317	757.5611	1070.4070	1290.9936	1314.6143	1254.2686	1089.6453	868.5160	559.4205	312.9015	210.7286	(83)
Total gains	1093.6046	1349.8782	1586.7343	1878.4122	2055.5639	2054.5843	1964.1460	1796.4307	1597.6581	1308.6777	1106.8565	1030.0723	(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	24.0103	24.0594	24.1077	24.3372	24.3806	24.5848	24.5848	24.6230	24.5058	24.3806	24.2929	24.2019	
alpha	2.6007	2.6040	2.6072	2.6225	2.6254	2.6390	2.6390	2.6415	2.6337	2.6254	2.6195	2.6135	
util living area													
	0.9875	0.9778	0.9597	0.9164	0.8406	0.7198	0.5921	0.6447	0.8271	0.9454	0.9802	0.9893	(86)
MIT	17.8544	18.1754	18.7042	19.4331	20.0947	20.5999	20.8323	20.7838	20.3641	19.4795	18.5437	17.8078	(87)
Th 2	20.0195	20.0213	20.0231	20.0314	20.0329	20.0402	20.0402	20.0416	20.0374	20.0329	20.0298	20.0265	(88)
util rest of house													
	0.9856	0.9744	0.9532	0.9018	0.8095	0.6582	0.4951	0.5518	0.7815	0.9332	0.9767	0.9877	(89)

MIT 2	17.1031	17.4235	17.9491	18.6706	19.3065	19.7701	19.9554	19.9251	19.5719	18.7262	17.7974	17.0611	(90)
Living area fraction									fLA = Living area / (4) =			0.2813	(91)
MIT	17.3145	17.6350	18.1615	18.8851	19.5282	20.0036	20.2021	20.1667	19.7948	18.9381	18.0073	17.2712	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3145	17.6350	18.1615	18.8851	19.5282	20.0036	20.2021	20.1667	19.7948	18.9381	18.0073	17.2712	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9777	0.9625	0.9362	0.8798	0.7903	0.6556	0.5129	0.5653	0.7678	0.9145	0.9658	0.9807	(94)
Useful gains	1069.1670	1299.1945	1485.5627	1652.6932	1624.5352	1346.9620	1007.4284	1015.4363	1226.6300	1196.7973	1068.9669	1010.1971	(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	4214.5752	4115.6544	3761.1735	3190.1095	2496.5685	1708.9788	1139.2381	1189.4463	1806.9012	2659.1794	3491.1042	4199.4266	(97)
Space heating kWh	2340.1837	1892.6611	1693.0544	1106.9398	648.7928	0.0000	0.0000	0.0000	0.0000	1088.0123	1743.9388	2372.7867	(98a)
Space heating requirement - total per year (kWh/year)												12886.3696	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2340.1837	1892.6611	1693.0544	1106.9398	648.7928	0.0000	0.0000	0.0000	0.0000	1088.0123	1743.9388	2372.7867	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12886.3696	
Space heating per m2											(98c) / (4) =	42.8645	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2972.9268	2340.3892	2399.9145	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6209	0.6962	0.6513	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1845.9115	1629.4571	1563.0011	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2264.4143	2164.0948	1973.4560	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	301.3220	397.7704	305.3785	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	75.3305	99.4426	76.3446	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												251.1177	(107)
Energy for space heating												42.8645	(99)
Energy for space cooling												0.8353	(108)
Total												43.6999	(109)
Fabric Energy Efficiency (TFEE)												43.7	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700	(1b)	x 2.5300	(2b) =	339.7031	(1b) - (3b)
First floor	166.3600	(1c)	x 2.9800	(2c) =	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		835.4559	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.1077	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3077	(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) =	0.2846	(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													
	0.3629	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2846	0.3060	0.3202	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(25)

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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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			134.2700			18.0000	2416.8600	(32d)
Internal Ceiling 1			134.2700			9.0000	1208.4300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27991.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		93.1094 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388
E15 Flat roof with parapet	7.6810	0.3000	2.3043
E16 Corner (normal)	30.5800	0.0570	1.7431
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822
E3 Sill	22.5200	0.0450	1.0134
E4 Jamb	99.5600	0.0510	5.0776
E5 Ground floor (normal)	49.3000	0.0640	3.1552
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		22.5815 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	165.4955 (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	156.0070	155.3019	154.6109	151.3648	150.7575	147.9303	147.9303	147.4068	149.0193	150.7575	151.9861	153.2706	(38)
Heat transfer coeff	321.5025	320.7974	320.1063	316.8603	316.2530	313.4258	313.4258	312.9023	314.5148	316.2530	317.4816	318.7660	(39)
Average = Sum(39)m / 12 =												316.8574	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0694	1.0671	1.0648	1.0540	1.0520	1.0426	1.0426	1.0408	1.0462	1.0520	1.0561	1.0603	(40)
HLP (average)												1.0540	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1327 (42)

Hot water usage for mixer showers

	105.5255	103.9396	101.6287	97.2073	93.9444	90.3056	88.2373	90.5307	93.0447	96.9516	101.4681	105.1212	(42a)

Hot water usage for baths

	33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

	46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day)		170.4703 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.3644	181.5879	176.8856	169.4881	163.5700	157.1720	154.5308	159.2108	164.1725	170.9130	178.4318	184.8481	(44)
Energy conte	293.5719	258.5788	271.8666	232.0208	220.1967	193.2613	186.8917	197.1363	202.4411	231.9273	254.2088	289.4274	(45)
Energy content (annual)										Total = Sum(45)m =		2831.5286	
Distribution loss (46)m = 0.15 x (45)m													
	44.0358	38.7868	40.7800	34.8031	33.0295	28.9892	28.0337	29.5704	30.3662	34.7891	38.1313	43.4141	(46)

Water storage loss:		
Store volume		400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		2.2000 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.1880 (55)

Total storage loss

	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
										Total per year (kWh/year) = Sum(64)m =		3539.0446	(64)

Electric shower(s)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)

Heat gains from water heating, kWh/month

	145.6850	129.3976	138.4680	123.6685	121.2877	110.7810	110.2138	113.6201	113.8333	125.1881	131.0460	144.3069	(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	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	(66)

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

59.1824	52.5653	42.7490	32.3637	24.1922	20.4241	22.0690	28.6861	38.5024	48.8877	57.0591	60.8272 (67)

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

684.7380	691.8434	673.9380	635.8193	587.7014	542.4773	512.2649	505.1594	523.0649	561.1835	609.3015	654.5255 (68)

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

56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292 (69)

Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100 (71)

Water heating gains (Table 5)

195.8131	192.5560	186.1129	171.7618	163.0211	153.8625	148.1368	152.7152	158.1018	168.2636	182.0083	193.9609 (72)

Total internal gains

1059.3177	1056.5489	1022.3840	959.5291	894.4990	836.3482	802.0549	806.1450	839.2533	897.9191	967.9532	1028.8980 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1349.0985	1604.2423	1888.1681	2182.8513	2369.9203	2338.7645	2235.5047	2051.4539	1831.8431	1537.2568	1325.5549	1269.7307	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.1846	24.2378	24.2901	24.5389	24.5861	24.8078	24.8078	24.8493	24.7219	24.5861	24.4909	24.3922	
alpha	2.6123	2.6159	2.6193	2.6359	2.6391	2.6539	2.6539	2.6566	2.6481	2.6391	2.6327	2.6261	
util living area													
	0.9796	0.9671	0.9415	0.8880	0.7982	0.6685	0.5378	0.5892	0.7842	0.9236	0.9701	0.9825	(86)
Living	18.6702	18.9060	19.3149	19.8416	20.3065	20.6403	20.7869	20.7573	20.4798	19.8555	19.1658	18.6303	
Non living	17.2532	17.5544	18.0738	18.7390	19.3054	19.6925	19.8381	19.8158	19.5241	18.7686	17.8939	17.2071	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.8082	18.9060	19.3149	19.8416	20.3065	20.6403	20.7869	20.7573	20.4798	19.8555	19.1658	18.9617	(87)
Th 2	20.0259	20.0278	20.0297	20.0386	20.0403	20.0480	20.0480	20.0495	20.0450	20.0403	20.0369	20.0334	(88)
util rest of house													
	0.9766	0.9623	0.9325	0.8698	0.7628	0.6049	0.4444	0.4977	0.7333	0.9076	0.9649	0.9799	(89)
MIT 2	18.9205	17.5544	18.0738	18.7390	19.3054	19.6925	19.8381	19.8158	19.5241	18.7686	17.8939	17.7164	(90)
Living area fraction									fLA = Living area / (4) =			0.2813	(91)
MIT	19.1702	17.9346	18.4230	19.0492	19.5871	19.9592	20.1051	20.0807	19.7930	19.0744	18.2517	18.0668	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1702	17.9346	18.4230	19.0492	19.5871	19.9592	20.1051	20.0807	19.7930	19.0744	18.2517	18.0668	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9734	0.9481	0.9132	0.8469	0.7435	0.5984	0.4504	0.5010	0.7176	0.8867	0.9515	0.9728	(94)
Useful gains	1313.1881	1520.9595	1724.3301	1848.6561	1761.9991	1399.4492	1006.9575	1027.6993	1314.4501	1363.0206	1261.3122	1235.1600	(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													
	4780.8164	4181.4813	3816.6126	3215.8862	2494.3134	1679.7090	1098.5845	1151.6881	1790.5261	2680.0438	3540.4691	4420.2550	(97)
Space heating kWh													
	2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98a)
Space heating requirement - total per year (kWh/year)												12444.2608	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12444.2608	
Space heating per m2											(98c) / (4) =	41.3939	(99)

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 %)	301.3337	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98)
Space heating efficiency (main heating system 1)													
	301.3337	301.3337	301.3337	301.3337	301.3337	0.0000	0.0000	0.0000	0.0000	301.3337	301.3337	301.3337	(210)
Space heating fuel (main heating system)													
	856.1656	593.3192	516.5895	326.6829	180.8101	0.0000	0.0000	0.0000	0.0000	325.1761	544.5767	786.4075	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)

Efficiency of water heater												167.9573	(216)
(217)m	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	(217)
Fuel for water heating, kWh/month													
	210.5668	186.2700	197.6437	172.7658	166.8800	149.6889	147.0505	153.1501	155.1544	173.8643	185.9763	208.0993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	51.8020	41.5575	37.4179	27.4140	21.1753	17.3004	19.3168	25.1088	32.6138	42.7911	48.3324	53.2417	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4129.7276	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.9573	
Water heating fuel used	2107.1102	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.0718	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6654.9095	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3303.7820	17.5600	647.5413	(240)
Space heating - main system 1 (low-rate cost)	825.9455	0.0940	77.6389	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1474.9771	19.6000	289.0955	(245)
Low-rate cost	632.1331	9.4000	59.4205	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	418.0718	18.5800	77.6777	(250)
Additional standing charges			7.0000	(251)
Total energy cost			1158.3739	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2065	(257)
SAP value		80.4421	
SAP rating (Section 12)		80	(258)
SAP band		C	

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 (high-rate cost)	3303.7820	0.1623	536.1808	(261)
Space heating - main system 1 (low-rate cost)	825.9455	0.1362	112.5316	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1474.9771	0.1479	218.2212	(264)
Water heating - low rate cost	632.1331	0.1242	78.4920	(264)
Space and water heating			945.4256	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.0718	0.1490	62.3010	(268)
Total CO2, kg/year			1007.7266	(272)
CO2 emissions per m2			3.3500	(273)
EI value			96.0931	
EI rating			96	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.1077 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3077 (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) =	0.2846 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2989	0.2846	0.2846	0.2633	0.2633	0.2348	0.2419	0.2277	0.2348	0.2491	0.2491	0.2704	(22b)
Effective ac	0.5447	0.5405	0.5405	0.5347	0.5347	0.5276	0.5293	0.5259	0.5276	0.5310	0.5310	0.5366	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			134.2700			18.0000	2416.8600	(32d)
Internal Ceiling 1			134.2700			9.0000	1208.4300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27991.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		93.1094 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388
E15 Flat roof with parapet	7.6810	0.3000	2.3043
E16 Corner (normal)	30.5800	0.0570	1.7431
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822
E3 Sill	22.5200	0.0450	1.0134
E4 Jamb	99.5600	0.0510	5.0776
E5 Ground floor (normal)	49.3000	0.0640	3.1552
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		22.5815 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	165.4955 (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	150.1642	149.0193	149.0193	147.4068	147.4068	145.4522	145.9199	144.9984	145.4522	146.4016	146.4016	147.9303	(38)
Heat transfer coeff	315.6596	314.5148	314.5148	312.9023	312.9023	310.9477	311.4154	310.4939	310.9477	311.8970	311.8970	313.4258	(39)
Average = Sum(39)m / 12 =												312.6265	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0500	1.0462	1.0462	1.0408	1.0408	1.0343	1.0359	1.0328	1.0343	1.0375	1.0375	1.0426	(40)
HLP (average)												1.0399	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.1327	(42)
Hot water usage for mixer showers	105.5255	103.9396	101.6287	97.2073	93.9444	90.3056	88.2373	90.5307	93.0447	96.9516	101.4681	105.1212	(42a)
Hot water usage for baths	33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

	46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125 (42c)
Average daily hot water use (litres/day)												170.4703 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	185.3644	181.5879	176.8856	169.4881	163.5700	157.1720	154.5308	159.2108	164.1725	170.9130	178.4318	184.8481	(44)
Energy conte	293.5719	258.5788	271.8666	232.0208	220.1967	193.2613	186.8917	197.1363	202.4411	231.9273	254.2088	289.4274	(45)
Energy content (annual)										Total = Sum(45)m =		2831.5286	
Distribution loss (46)m = 0.15 x (45)m													
	44.0358	38.7868	40.7800	34.8031	33.0295	28.9892	28.0337	29.5704	30.3662	34.7891	38.1313	43.4141	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
										Total per year (kWh/year) = Sum(64)m =		3539.0446	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
	145.6850	129.3976	138.4680	123.6685	121.2877	110.7810	110.2138	113.6201	113.8333	125.1881	131.0460	144.3069	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.1824	52.5653	42.7490	32.3637	24.1922	20.4241	22.0690	28.6861	38.5024	48.8877	57.0591	60.8272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7380	691.8434	673.9380	635.8193	587.7014	542.4773	512.2649	505.1594	523.0649	561.1835	609.3015	654.5255	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)													
	195.8131	192.5560	186.1129	171.7618	163.0211	153.8625	148.1368	152.7152	158.1018	168.2636	182.0083	193.9609	(72)
Total internal gains													
	1059.3177	1056.5489	1022.3840	959.5291	894.4990	836.3482	802.0549	806.1450	839.2533	897.9191	967.9532	1028.8980	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	11.9814	0.7200	0.7000	0.7700	3.6408	(74)
East	12.2400	22.3313	0.7200	0.7000	0.7700	95.4684	(76)
South	3.6600	50.9848	0.7200	0.7000	0.7700	65.1757	(78)
West	20.8200	22.3313	0.7200	0.7000	0.7700	162.3898	(80)

Solar gains	326.6747	555.8489	867.8441	1262.6991	1482.8626	1615.7002	1524.9525	1355.2812	1078.1677	692.8238	413.0750	268.8136	(83)
Total gains	1385.9924	1612.3978	1890.2281	2222.2282	2377.3616	2452.0484	2327.0074	2161.4262	1917.4210	1590.7429	1381.0281	1297.7116	(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	24.6323	24.7219	24.7219	24.8493	24.8493	25.0055	24.9680	25.0421	25.0055	24.9294	24.9294	24.8078	
alpha	2.6422	2.6481	2.6481	2.6566	2.6566	2.6670	2.6645	2.6695	2.6670	2.6620	2.6620	2.6539	
util living area													
	0.9756	0.9631	0.9324	0.8633	0.7450	0.5493	0.3906	0.4266	0.7047	0.8994	0.9618	0.9790	(86)
Living	18.8650	19.0698	19.4975	20.0257	20.4802	20.7700	20.8538	20.8456	20.6346	20.0545	19.3766	18.8344	
Non living	17.5124	17.7744	18.3152	18.9741	19.5155	19.8266	19.8936	19.8920	19.7010	19.0239	18.1722	17.4776	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9078	19.0698	19.4975	20.0257	20.4802	20.7700	20.8538	20.8456	20.6346	20.0545	19.3766	19.1373	(87)
Th 2	20.0419	20.0450	20.0450	20.0495	20.0495	20.0548	20.0535	20.0561	20.0548	20.0522	20.0522	20.0480	(88)
util rest of house													
	0.9719	0.9575	0.9216	0.8405	0.6988	0.4678	0.2807	0.3131	0.6358	0.8774	0.9548	0.9758	(89)
MIT 2	19.0335	17.7744	18.3152	18.9741	19.5155	19.8266	19.8936	19.8920	19.7010	19.0239	18.1722	17.9408	(90)
Living area fraction										fLA = Living area / (4) =		0.2813	(91)
MIT	19.2795	18.1389	18.6478	19.2700	19.7869	20.0920	20.1638	20.1603	19.9636	19.3139	18.5110	18.2774	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2795	18.1389	18.6478	19.2700	19.7869	20.0920	20.1638	20.1603	19.9636	19.3139	18.5110	18.2774	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9684	0.9425	0.9014	0.8180	0.6844	0.4712	0.2941	0.3263	0.6282	0.8556	0.9395	0.9678	(94)
Useful gains	1342.1619	1519.6059	1703.8780	1817.8408	1626.9916	1155.4361	684.3170	705.3370	1204.5810	1361.1002	1297.4751	1255.8887	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4475.8827	3943.6582	3537.6152	2931.8856	2123.6360	1272.4001	704.9726	732.8504	1481.2435	2405.9329	3278.3550	4130.1456	(97)
Space heating kWh													
	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98a)
Space heating requirement - total per year (kWh/year)												10838.4037	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10838.4037	
Space heating per m2											(98c) / (4) =	36.0523	(99)

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 %)	301.1745	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98)
Space heating efficiency (main heating system 1)													
	301.1745	301.1745	301.1745	301.1745	301.1745	0.0000	0.0000	0.0000	0.0000	301.1745	301.1745	301.1745	(210)
Space heating fuel (main heating system)													
	774.1319	540.8701	452.9933	266.3280	122.6875	0.0000	0.0000	0.0000	0.0000	258.1080	473.5571	710.0358	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
Efficiency of water heater												167.9429	(216)
(217)m	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	(217)
Fuel for water heating, kWh/month													
	210.5849	186.2859	197.6606	172.7806	166.8943	149.7017	147.0631	153.1632	155.1677	173.8792	185.9923	208.1171	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	51.8020	41.5575	37.4179	27.4140	21.1753	17.3004	19.3168	25.1088	32.6138	42.7911	48.3324	53.2417	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3598.7117	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												167.9429	
Water heating fuel used												2107.2906	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												418.0718	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												6124.0740	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2878.9694	26.7600	857.9329	(240)
Space heating - main system 1 (low-rate cost)	719.7423	0.1460	105.0824	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1475.1034	29.8000	439.5808	(245)
Low-rate cost	632.1872	14.6000	92.2993	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	418.0718	28.2800	118.2307	(250)
Additional standing charges			4.0000	(251)
Total energy cost			1617.1261	(255)

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 (high-rate cost)	2878.9694	0.1629	468.9619	(261)
Space heating - main system 1 (low-rate cost)	719.7423	0.1367	98.4216	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1475.1034	0.1479	218.2399	(264)
Water heating - low rate cost	632.1872	0.1242	78.4988	(264)
Space and water heating			864.1221	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.0718	0.1490	62.3010	(268)
Total CO2, kg/year			926.4230	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2878.9694	1.2858	4627.3179	(275)
Space heating - main system 1 (low-rate cost)	719.7423	1.4948	1075.9016	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1475.1034	1.5530	2290.8820	(278)
Water heating - low rate cost	632.1872	1.4444	913.1125	(278)
Space and water heating			8907.2141	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	418.0718	1.5547	649.9948	(282)
Total Primary energy kWh/year			9557.2089	(286)

SAP 10 EPC IMPROVEMENTS

P1 Oakley

Current energy efficiency rating: C 80
Current environmental impact rating: A 96

N Solar water heating	SAP increase too small
U Solar photovoltaic panels	Recommended
V2 Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 3.3	-£ 306	-150 kg (16.1%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.9	-£ 95	-47 kg (5.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£306	0.50 kg/m²	B 84	A 97
Total Savings	£306	0.50 kg/m²		

Potential energy efficiency rating: B 84
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1617	£1617	£0
Space heating	£967	£967	£0
Water heating	£532	£532	£0
Lighting	£118	£118	£0
Generated (PV)	-£0	-£306	£306
Total cost of fuels	£1617	£1311	£306
Total cost of uses	£1617	£1311	£306
Delivered energy	20 kWh/m²	17 kWh/m²	4 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.8 tonnes	0.1 tonnes
CO2 emissions per m²	3 kg/m²	3 kg/m²	0 kg/m²
Primary energy	32 kWh/m²	26 kWh/m²	5 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	300.6300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	835.4559	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.1077	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3077	(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) =	0.2846	(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	0.3629	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2846	0.3060	0.3202	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			134.2700			18.0000	2416.8600	(32d)
Internal Ceiling 1			134.2700			9.0000	1208.4300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27991.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		93.1094 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388
E15 Flat roof with parapet	7.6810	0.3000	2.3043
E16 Corner (normal)	30.5800	0.0570	1.7431
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822
E3 Sill	22.5200	0.0450	1.0134
E4 Jamb	99.5600	0.0510	5.0776
E5 Ground floor (normal)	49.3000	0.0640	3.1552
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		22.5815 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	165.4955 (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	156.0070	155.3019	154.6109	151.3648	150.7575	147.9303	147.9303	147.4068	149.0193	150.7575	151.9861	153.2706	(38)
Heat transfer coeff	321.5025	320.7974	320.1063	316.8603	316.2530	313.4258	313.4258	312.9023	314.5148	316.2530	317.4816	318.7660	(39)
Average = Sum(39)m / 12 =												316.8574	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0694	1.0671	1.0648	1.0540	1.0520	1.0426	1.0426	1.0408	1.0462	1.0520	1.0561	1.0603	(40)
HLP (average)												1.0540	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1327 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
105.5255	103.9396	101.6287	97.2073	93.9444	90.3056	88.2373	90.5307	93.0447	96.9516	101.4681	105.1212	(42a)

Hot water usage for baths

33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day)	170.4703 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.3644	181.5879	176.8856	169.4881	163.5700	157.1720	154.5308	159.2108	164.1725	170.9130	178.4318	184.8481	(44)
Energy conte	293.5719	258.5788	271.8666	232.0208	220.1967	193.2613	186.8917	197.1363	202.4411	231.9273	254.2088	289.4274	(45)
Energy content (annual)										Total = Sum(45)m =		2831.5286	

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

44.0358	38.7868	40.7800	34.8031	33.0295	28.9892	28.0337	29.5704	30.3662	34.7891	38.1313	43.4141	(46)

Water storage loss:

Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
									Total per year (kWh/year) = Sum(64)m =			3539.0446	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month													
	145.6850	129.3976	138.4680	123.6685	121.2877	110.7810	110.2138	113.6201	113.8333	125.1881	131.0460	144.3069	(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	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.1824	52.5653	42.7490	32.3637	24.1922	20.4241	22.0690	28.6861	38.5024	48.8877	57.0591	60.8272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	684.7380	691.8434	673.9380	635.8193	587.7014	542.4773	512.2649	505.1594	523.0649	561.1835	609.3015	654.5255	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)													
	195.8131	192.5560	186.1129	171.7618	163.0211	153.8625	148.1368	152.7152	158.1018	168.2636	182.0083	193.9609	(72)
Total internal gains													
	1059.3177	1056.5489	1022.3840	959.5291	894.4990	836.3482	802.0549	806.1450	839.2533	897.9191	967.9532	1028.8980	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8700	10.6334	0.7200	0.7000	0.7700	3.2311	(74)
East	12.2400	19.6403	0.7200	0.7000	0.7700	83.9639	(76)
South	3.6600	46.7521	0.7200	0.7000	0.7700	59.7648	(78)
West	20.8200	19.6403	0.7200	0.7000	0.7700	142.8209	(80)

Solar gains	289.7808	547.6934	865.7841	1223.3223	1475.4212	1502.4163	1433.4498	1245.3090	992.5898	639.3377	357.6017	240.8327	(83)
Total gains	1349.0985	1604.2423	1888.1681	2182.8513	2369.9203	2338.7645	2235.5047	2051.4539	1831.8431	1537.2568	1325.5549	1269.7307	(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	24.1846	24.2378	24.2901	24.5389	24.5861	24.8078	24.8078	24.8493	24.7219	24.5861	24.4909	24.3922	
alpha	2.6123	2.6159	2.6193	2.6359	2.6391	2.6539	2.6539	2.6566	2.6481	2.6391	2.6327	2.6261	
util living area													
	0.9796	0.9671	0.9415	0.8880	0.7982	0.6685	0.5378	0.5892	0.7842	0.9236	0.9701	0.9825	(86)
Living	18.6702	18.9060	19.3149	19.8416	20.3065	20.6403	20.7869	20.7573	20.4798	19.8555	19.1658	18.6303	
Non living	17.2532	17.5544	18.0738	18.7390	19.3054	19.6925	19.8381	19.8158	19.5241	18.7686	17.8939	17.2071	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.8082	18.9060	19.3149	19.8416	20.3065	20.6403	20.7869	20.7573	20.4798	19.8555	19.1658	18.9617	(87)
Th 2	20.0259	20.0278	20.0297	20.0386	20.0403	20.0480	20.0480	20.0495	20.0450	20.0403	20.0369	20.0334	(88)
util rest of house													
	0.9766	0.9623	0.9325	0.8698	0.7628	0.6049	0.4444	0.4977	0.7333	0.9076	0.9649	0.9799	(89)
MIT 2	18.9205	17.5544	18.0738	18.7390	19.3054	19.6925	19.8381	19.8158	19.5241	18.7686	17.8939	17.7164	(90)
Living area fraction									fLA = Living area / (4) =			0.2813	(91)
MIT	19.1702	17.9346	18.4230	19.0492	19.5871	19.9592	20.1051	20.0807	19.7930	19.0744	18.2517	18.0668	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1702	17.9346	18.4230	19.0492	19.5871	19.9592	20.1051	20.0807	19.7930	19.0744	18.2517	18.0668	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9734	0.9481	0.9132	0.8469	0.7435	0.5984	0.4504	0.5010	0.7176	0.8867	0.9515	0.9728	(94)
Useful gains	1313.1881	1520.9595	1724.3301	1848.6561	1761.9991	1399.4492	1006.9575	1027.6993	1314.4501	1363.0206	1261.3122	1235.1600	(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													
	4780.8164	4181.4813	3816.6126	3215.8862	2494.3134	1679.7090	1098.5845	1151.6881	1790.5261	2680.0438	3540.4691	4420.2550	(97)
Space heating kWh													
	2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98a)
Space heating requirement - total per year (kWh/year)												12444.2608	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 12444.2608

Space heating per m2 (98c) / (4) = 41.3939 (99)

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 %) 301.3337 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2579.9155	1787.8706	1556.6582	984.4057	544.8418	0.0000	0.0000	0.0000	0.0000	979.8653	1640.9930	2369.7107	(98)
Space heating efficiency (main heating system 1)													
	301.3337	301.3337	301.3337	301.3337	301.3337	0.0000	0.0000	0.0000	0.0000	301.3337	301.3337	301.3337	(210)
Space heating fuel (main heating system)													
	856.1656	593.3192	516.5895	326.6829	180.8101	0.0000	0.0000	0.0000	0.0000	325.1761	544.5767	786.4075	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
Efficiency of water heater												167.9573	(216)
(217)m	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	167.9573	(217)
Fuel for water heating, kWh/month													
	210.5668	186.2700	197.6437	172.7658	166.8800	149.6889	147.0505	153.1501	155.1544	173.8643	185.9763	208.0993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	51.8020	41.5575	37.4179	27.4140	21.1753	17.3004	19.3168	25.1088	32.6138	42.7911	48.3324	53.2417	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-41.5675	-63.7005	-99.3428	-119.3947	-132.9102	-118.3046	-116.6147	-106.8755	-90.5146	-75.0249	-47.0004	-35.1756	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1 4129.7276 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 167.9573

Water heating fuel used 2107.1102 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year 0.0000 (231)

Electricity for lighting (calculated in Appendix L) 418.0718 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation -1046.4260 (233)

Wind generation 0.0000 (234)

Hydro-electric generation (Appendix N) 0.0000 (235a)

Electricity generated - Micro CHP (Appendix N) 0.0000 (235)

Appendix Q - special features

Energy saved or generated -0.0000 (236)

Energy used 0.0000 (237)

Total delivered energy for all uses 5608.4835 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3303.7820	17.5600	647.5413	(240)
Space heating - main system 1 (low-rate cost)	825.9455	0.0940	77.6389	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1474.9771	19.6000	289.0955	(245)
Low-rate cost	632.1331	9.4000	59.4205	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	418.0718	18.5800	77.6777	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1046.4260	18.5800	-194.4260	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-194.4260	(252)
Total energy cost			963.9480	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0040	(257)
SAP value		83.7247	
SAP rating (Section 12)		84	(258)
SAP band		B	

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 (high-rate cost)	3303.7820	0.1623	536.1808	(261)
Space heating - main system 1 (low-rate cost)	825.9455	0.1362	112.5316	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1474.9771	0.1479	218.2212	(264)
Water heating - low rate cost	632.1331	0.1242	78.4920	(264)
Space and water heating			945.4256	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.0718	0.1490	62.3010	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1046.4260	0.1381	-144.4916	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-144.4916	(269)
Total CO2, kg/year			863.2350	(272)
CO2 emissions per m2			2.8700	(273)
EI value			96.6533	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	134.2700 (1b)	x	2.5300 (2b)	=	339.7031	(1b) - (3b)
First floor	166.3600 (1c)	x	2.9800 (2c)	=	495.7528	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 300.6300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		835.4559	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.1077	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3077	(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) =	0.2846	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2989	0.2846	0.2846	0.2633	0.2633	0.2348	0.2419	0.2277	0.2348	0.2491	0.2491	0.2704	(22b)
Effective ac	0.5447	0.5405	0.5405	0.5347	0.5347	0.5276	0.5293	0.5259	0.5276	0.5310	0.5310	0.5366	(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	
Front Door			1.9600	1.2000	2.3520			(26a)
Other Ext Door			16.9100	1.2000	20.2920			(26a)
Windows (Uw = 1.20)			37.5900	1.1450	43.0420			(27)
Heat Loss Floor 1			166.3500	0.1100	18.2985	0.0000	0.0000	(28a)
External Wall 1	255.8324	54.5400	201.2924	0.1900	38.2456	60.0000	12077.5440	(29a)
Timber Clad	32.2900	1.9200	30.3700	0.1600	4.8592	60.0000	1822.2000	(29a)
External Roof 1	14.1600		14.1600	0.1500	2.1240	9.0000	127.4400	(30)
External Roof 3	152.2300		152.2300	0.0900	13.7007	9.0000	1370.0700	(30)
Total net area of external elements Aum(A, m2)			620.8624					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.9139			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)

Internal Wall 2	143.6600	9.0000	1292.9400 (32c)
Internal Floor 1	134.2700	18.0000	2416.8600 (32d)
Internal Ceiling 1	134.2700	9.0000	1208.4300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27991.4840 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 93.1094 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	60.1370	0.1370	8.2388
E15 Flat roof with parapet	7.6810	0.3000	2.3043
E16 Corner (normal)	30.5800	0.0570	1.7431
E17 Corner (inverted - internal area greater than external area)	8.4900	-0.0510	-0.4330
E2 Other lintels (including other steel lintels)	30.8800	0.0480	1.4822
E3 Sill	22.5200	0.0450	1.0134
E4 Jamb	99.5600	0.0510	5.0776
E5 Ground floor (normal)	49.3000	0.0640	3.1552
E6 Intermediate floor within a dwelling	54.8300	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 22.5815 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 165.4955 (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	150.1642	149.0193	149.0193	147.4068	147.4068	145.4522	145.9199	144.9984	145.4522	146.4016	146.4016	147.9303	(38)
Heat transfer coeff	315.6596	314.5148	314.5148	312.9023	312.9023	310.9477	311.4154	310.4939	310.9477	311.8970	311.8970	313.4258	(39)
Average = Sum(39)m / 12 =												312.6265	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0500	1.0462	1.0462	1.0408	1.0408	1.0343	1.0359	1.0328	1.0343	1.0375	1.0375	1.0426	(40)
HLP (average)												1.0399	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1327 (42)
Hot water usage for mixer showers

105.5255	103.9396	101.6287	97.2073	93.9444	90.3056	88.2373	90.5307	93.0447	96.9516	101.4681	105.1212	(42a)

Hot water usage for baths

33.1264	32.6345	31.9416	30.6642	29.7077	28.6471	28.0742	28.7622	29.5113	30.6461	31.9499	33.0144	(42b)

Hot water usage for other uses

46.7125	45.0138	43.3152	41.6166	39.9179	38.2193	38.2193	39.9179	41.6166	43.3152	45.0138	46.7125	(42c)

Average daily hot water use (litres/day) 170.4703 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.3644	181.5879	176.8856	169.4881	163.5700	157.1720	154.5308	159.2108	164.1725	170.9130	178.4318	184.8481	(44)
Energy conte	293.5719	258.5788	271.8666	232.0208	220.1967	193.2613	186.8917	197.1363	202.4411	231.9273	254.2088	289.4274	(45)
Energy content (annual)										Total = Sum(45)m =		2831.5286	
Distribution loss (46)m = 0.15 x (45)m	44.0358	38.7868	40.7800	34.8031	33.0295	28.9892	28.0337	29.5704	30.3662	34.7891	38.1313	43.4141	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
									Total per year (kWh/year) = Sum(64)m =			3539.0446	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	145.6850	129.3976	138.4680	123.6685	121.2877	110.7810	110.2138	113.6201	113.8333	125.1881	131.0460	144.3069	(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	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	187.9649	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.1824	52.5653	42.7490	32.3637	24.1922	20.4241	22.0690	28.6861	38.5024	48.8877	57.0591	60.8272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	684.7380	691.8434	673.9380	635.8193	587.7014	542.4773	512.2649	505.1594	523.0649	561.1835	609.3015	654.5255	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	56.9292	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	-125.3100	(71)
Water heating gains (Table 5)	195.8131	192.5560	186.1129	171.7618	163.0211	153.8625	148.1368	152.7152	158.1018	168.2636	182.0083	193.9609	(72)
Total internal gains	1059.3177	1056.5489	1022.3840	959.5291	894.4990	836.3482	802.0549	806.1450	839.2533	897.9191	967.9532	1028.8980	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North	0.8700	11.9814	0.7200	0.7000	0.7700	3.6408	(74)
East	12.2400	22.3313	0.7200	0.7000	0.7700	95.4684	(76)
South	3.6600	50.9848	0.7200	0.7000	0.7700	65.1757	(78)
West	20.8200	22.3313	0.7200	0.7000	0.7700	162.3898	(80)

Solar gains	326.6747	555.8489	867.8441	1262.6991	1482.8626	1615.7002	1524.9525	1355.2812	1078.1677	692.8238	413.0750	268.8136	(83)
Total gains	1385.9924	1612.3978	1890.2281	2222.2282	2377.3616	2452.0484	2327.0074	2161.4262	1917.4210	1590.7429	1381.0281	1297.7116	(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	24.6323	24.7219	24.7219	24.8493	24.8493	25.0055	24.9680	25.0421	25.0055	24.9294	24.9294	24.8078	
alpha	2.6422	2.6481	2.6481	2.6566	2.6566	2.6670	2.6645	2.6695	2.6670	2.6620	2.6620	2.6539	
util living area	0.9756	0.9631	0.9324	0.8633	0.7450	0.5493	0.3906	0.4266	0.7047	0.8994	0.9618	0.9790	(86)
Living	18.8650	19.0698	19.4975	20.0257	20.4802	20.7700	20.8538	20.8456	20.6346	20.0545	19.3766	18.8344	
Non living	17.5124	17.7744	18.3152	18.9741	19.5155	19.8266	19.8936	19.8920	19.7010	19.0239	18.1722	17.4776	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9078	19.0698	19.4975	20.0257	20.4802	20.7700	20.8538	20.8456	20.6346	20.0545	19.3766	19.1373	(87)
Th 2	20.0419	20.0450	20.0450	20.0495	20.0495	20.0548	20.0535	20.0561	20.0548	20.0522	20.0522	20.0480	(88)
util rest of house	0.9719	0.9575	0.9216	0.8405	0.6988	0.4678	0.2807	0.3131	0.6358	0.8774	0.9548	0.9758	(89)
MIT 2	19.0335	17.7744	18.3152	18.9741	19.5155	19.8266	19.8936	19.8920	19.7010	19.0239	18.1722	17.9408	(90)
Living area fraction									fLA = Living area / (4) =			0.2813	(91)
MIT	19.2795	18.1389	18.6478	19.2700	19.7869	20.0920	20.1638	20.1603	19.9636	19.3139	18.5110	18.2774	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2795	18.1389	18.6478	19.2700	19.7869	20.0920	20.1638	20.1603	19.9636	19.3139	18.5110	18.2774	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9684	0.9425	0.9014	0.8180	0.6844	0.4712	0.2941	0.3263	0.6282	0.8556	0.9395	0.9678	(94)
Useful gains	1342.1619	1519.6059	1703.8780	1817.8408	1626.9916	1155.4361	684.3170	705.3370	1204.5810	1361.1002	1297.4751	1255.8887	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4475.8827	3943.6582	3537.6152	2931.8856	2123.6360	1272.4001	704.9726	732.8504	1481.2435	2405.9329	3278.3550	4130.1456	(97)
Space heating kWh	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98a)
Space heating requirement - total per year (kWh/year)												10838.4037	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10838.4037	
Space heating per m2										(98c) / (4) =		36.0523	(99)

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 %)	301.1745 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2331.4883	1628.9632	1364.3005	802.1122	369.5034	0.0000	0.0000	0.0000	0.0000	777.3555	1426.2335	2138.4472	(98)
Space heating efficiency (main heating system 1)	301.1745	301.1745	301.1745	301.1745	301.1745	0.0000	0.0000	0.0000	0.0000	301.1745	301.1745	301.1745	(210)
Space heating fuel (main heating system)	774.1319	540.8701	452.9933	266.3280	122.6875	0.0000	0.0000	0.0000	0.0000	258.1080	473.5571	710.0358	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	353.6623	312.8540	331.9570	290.1728	280.2871	251.4133	246.9821	257.2267	260.5931	292.0177	312.3608	349.5178	(64)
Efficiency of water heater												167.9429	(216)
(217)m	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	167.9429	(217)
Fuel for water heating, kWh/month	210.5849	186.2859	197.6606	172.7806	166.8943	149.7017	147.0631	153.1632	155.1677	173.8792	185.9923	208.1171	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	51.8020	41.5575	37.4179	27.4140	21.1753	17.3004	19.3168	25.1088	32.6138	42.7911	48.3324	53.2417	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.8543	-63.8889	-98.3527	-120.4083	-130.7174	-123.9731	-121.3345	-113.0079	-95.7980	-78.8219	-52.6957	-38.4942	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	3598.7117	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.9429	
Water heating fuel used	2107.2906	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.0718	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1083.3469	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5040.7271	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2878.9694	26.7600	857.9329	(240)
Space heating - main system 1 (low-rate cost)	719.7423	0.1460	105.0824	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1475.1034	29.8000	439.5808	(245)
Low-rate cost	632.1872	14.6000	92.2993	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	418.0718	28.2800	118.2307	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1083.3469	28.2800	-306.3705	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-306.3705	(252)
Total energy cost			1310.7556	(255)

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 (high-rate cost)	2878.9694	0.1629	468.9619	(261)
Space heating - main system 1 (low-rate cost)	719.7423	0.1367	98.4216	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1475.1034	0.1479	218.2399	(264)
Water heating - low rate cost	632.1872	0.1242	78.4988	(264)
Space and water heating			864.1221	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.0718	0.1490	62.3010	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1083.3469	0.1380	-149.5348	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-149.5348	(269)
Total CO2, kg/year			776.8883	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2878.9694	1.2858	4627.3179	(275)
Space heating - main system 1 (low-rate cost)	719.7423	1.4948	1075.9016	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1475.1034	1.5530	2290.8820	(278)
Water heating - low rate cost	632.1872	1.4444	913.1125	(278)
Space and water heating			8907.2141	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	418.0718	1.5547	649.9948	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1083.3469	1.5146	-1640.8482	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1640.8482	(283)
Total Primary energy kWh/year			7916.3607	(286)

Full SAP Calculation Printout

Property Reference	P2 Oakley	**Issued on Date**	16/01/2024
Assessment Reference	P2 Oakley	**Prop Type Ref**	Detached
Property	2, Windsor		

SAP Rating	83 B	**DER**	3.04	**TER**	8.28
Environmental	97 A	**% DER < TER**			63.29
CO_2 Emissions (t/year)	0.73	**DFEE**	40.55	**TFEE**	43.04
Compliance Check	See BREL	**% DFEE < TFEE**			5.79
% DPER < TPER	27.75	**DPER**	31.80	**TPER**	44.01

Assessor Details	Mrs. Naomi Sadler	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne Homes		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	6 * 10 =	60.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3073	(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) =	0.2843	(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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	28365.3320			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							104.8393	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126	
E3 Sill	27.3000	0.0450	1.2285	
E4 Jamb	64.4000	0.0510	3.2844	
E5 Ground floor (normal)	54.9200	0.0640	3.5149	
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000	
E16 Corner (normal)	38.5700	0.0570	2.1985	
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430	
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100	
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568	
R6 Flat ceiling	3.4200	0.1200	0.4104	
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607	
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.1558 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.7410 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.8882	286.2608	285.6458	282.7573	282.2168	279.7010	279.7010	279.2351	280.6700	282.2168	283.3101	284.4531	(39)

Average = Sum(39)m / 12 = 282.7547

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0603	1.0580	1.0558	1.0451	1.0431	1.0338	1.0338	1.0321	1.0374	1.0431	1.0471	1.0513	(40)
HLP (average)												1.0451	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)

Hot water usage for mixer showers

104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)

Energy content (annual) Total = Sum(45)m = 2807.3415

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

43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:
Store volume 400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.2000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1880 (55)
Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)

Total per year (kWh/year) = Sum(64)m = 3514.8575 (64)
12Total per year (kWh/year) 3515 (64)
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	227.4242	251.7911	227.4242	235.0050	227.4242	235.0050	227.4242	227.4242	235.0050	227.4242	235.0050	227.4242	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains	925.4849	951.1257	909.0229	878.2169	831.4746	801.3135	768.9084	768.9444	793.2137	819.8662	871.5698	904.5009	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1206.8613	1500.3902	1816.1712	2213.6465	2484.4829	2501.9713	2384.4236	2144.7373	1851.5621	1471.8019	1222.0705	1136.1832	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.4646	27.5248	27.5840	27.8658	27.9192	28.1703	28.1703	28.2173	28.0730	27.9192	27.8114	27.6997	
alpha	2.8310	2.8350	2.8389	2.8577	2.8613	2.8780	2.8780	2.8812	2.8715	2.8613	2.8541	2.8466	
util living area	0.9848	0.9716	0.9436	0.8750	0.7610	0.6086	0.4758	0.5354	0.7581	0.9256	0.9753	0.9872	(86)
Living	18.8513	19.1057	19.5145	20.0474	20.4746	20.7406	20.8384	20.8156	20.5889	19.9967	19.3300	18.8144	
Non living	17.4756	17.8005	18.3189	18.9872	19.4973	19.7952	19.8862	19.8710	19.6442	18.9387	18.0948	17.4334	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9008	19.1057	19.5145	20.0474	20.4746	20.7406	20.8384	20.8156	20.5889	19.9967	19.3300	19.1201	(87)
Th 2	20.0333	20.0353	20.0371	20.0459	20.0476	20.0553	20.0553	20.0567	20.0523	20.0476	20.0442	20.0408	(88)
util rest of house	0.9824	0.9671	0.9343	0.8543	0.7210	0.5427	0.3868	0.4449	0.7024	0.9090	0.9706	0.9851	(89)
MIT 2	19.0136	17.8005	18.3189	18.9872	19.4973	19.7952	19.8862	19.8710	19.6442	18.9387	18.0948	17.9033	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.1970	18.0702	18.5660	19.2063	19.6992	19.9905	20.0830	20.0662	19.8394	19.1574	18.3501	18.1547	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1970	18.0702	18.5660	19.2063	19.6992	19.9905	20.0830	20.0662	19.8394	19.1574	18.3501	18.1547	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9798	0.9545	0.9161	0.8324	0.7046	0.5378	0.3896	0.4459	0.6881	0.8889	0.9590	0.9796	(94)
Useful gains	1182.5201	1432.1130	1663.7705	1842.6586	1750.4444	1345.5064	928.9537	956.3815	1274.0116	1308.2730	1171.9755	1112.9550	(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	4273.7659	3770.1117	3446.6019	2914.1683	2257.5196	1507.7391	974.1869	1023.7375	1610.8727	2415.0321	3187.2607	3969.4670	(97)
Space heating kWh	2299.8869	1571.1351	1326.4265	771.4870	377.2640	0.0000	0.0000	0.0000	0.0000	823.4288	1451.0054	2125.2449	(98a)
Space heating requirement - total per year (kWh/year)												10745.8785	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2299.8869	1571.1351	1326.4265	771.4870	377.2640	0.0000	0.0000	0.0000	0.0000	823.4288	1451.0054	2125.2449	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10745.8785	
Space heating per m2											(98c) / (4) =	39.7172	(99)

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 %)												299.9213	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2299.8869	1571.1351	1326.4265	771.4870	377.2640	0.0000	0.0000	0.0000	0.0000	823.4288	1451.0054	2125.2449	(98)
Space heating efficiency (main heating system 1)	299.9213	299.9213	299.9213	299.9213	0.0000	0.0000	0.0000	0.0000	299.9213	299.9213	299.9213	299.9213	(210)
Space heating fuel (main heating system)	766.8302	523.8492	442.2582	257.2298	125.7877	0.0000	0.0000	0.0000	0.0000	274.5483	483.7954	708.6009	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8292	(216)
(217)m	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	(217)
Fuel for water heating, kWh/month	209.2332	185.0960	196.4108	171.7167	165.8866	148.8195	146.2115	152.2635	154.2424	172.8165	184.8243	206.7849	(219)
Space cooling fuel 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	(221)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(232)
Lighting	46.2884	37.1343	33.4353	24.4961	18.9215	15.4590	17.2608	22.4363	29.1425	38.2366	43.1881	47.5749	(233a)
Electricity generated by PVs (Appendix M) (negative quantity)	-17.7433	-28.0061	-44.9990	-56.0380	-64.6274	-60.2437	-59.4044	-53.5134	-44.0596	-33.9250	-20.4026	-14.9597	(233a)m
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)m
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)m
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)m
Electricity generated by PVs (Appendix M) (negative quantity)	-2.2913	-5.4259	-11.9395	-20.2708	-29.6457	-32.4418	-32.0562	-26.3962	-18.5256	-8.8133	-3.3614	-1.8059	(233b)m
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)m
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)m
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)m
Annual totals kWh/year													
Space heating fuel - main system 1												3582.8997	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater	167.8292	
Water heating fuel used	2094.3060	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	373.5739	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5359.8840	(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 (high-rate cost)	2866.3198	0.1628	466.5218	(261)
Space heating - main system 1 (low-rate cost)	716.5799	0.1366	97.9112	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.0142	0.1479	216.8891	(264)
Water heating - low rate cost	628.2918	0.1242	78.0129	(264)
Space and water heating			859.3349	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	373.5739	0.1490	55.6699	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.9222	0.1371	-68.2603	
PV Unit electricity exported	-192.9735	0.1219	-23.5159	
Total			-91.7762	(269)
Total CO2, kg/year			823.2286	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2866.3198	1.2854	4605.6223	(275)
Space heating - main system 1 (low-rate cost)	716.5799	1.4944	1070.8586	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1466.0142	1.5530	2276.7442	(278)
Water heating - low rate cost	628.2918	1.4444	907.4774	(278)
Space and water heating			8860.7025	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	373.5739	1.5547	580.8120	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.9222	1.5112	-752.4475	
PV Unit electricity exported	-192.9735	0.4470	-86.2677	
Total			-838.7152	(283)
Total Primary energy kWh/year			8602.7993	(286)
Dwelling Primary energy Rate (DPER)			31.8000	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 270.5600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3037	(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) = 0.2809 (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	0.3581	0.3511	0.3441	0.3090	0.3020	0.2668	0.2668	0.2598	0.2809	0.3020	0.3160	0.3300	(22b)
Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545	(25)

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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 Semi-glazed door			4.4800	1.0000	4.4800			(26a)
TER Opening Type (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1300	17.6150			(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133			(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1800	10.4922			(29a)
External Roof 1	5.1300		5.1300	0.1100	0.5643			(30)
External Roof 3	131.0000		131.0000	0.1100	14.4100			(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	133.3969			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 104.8393 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	29.4300	0.0500	1.4715
E3	Sill	27.3000	0.0500	1.3650
E4	Jamb	64.4000	0.0500	3.2200
E5	Ground floor (normal)	54.9200	0.1600	8.7872
E6	Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16	Corner (normal)	38.5700	0.0900	3.4713
E17	Corner (inverted - internal area greater than external area)	16.5300	-0.0900	-1.4877
E13	Gable (insulation at rafter level)	1.0000	0.0800	0.0800
E11	Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6	Flat ceiling	3.4200	0.0600	0.2052
E12	Gable (insulation at ceiling level)	24.1198	0.0600	1.4472
E10	Eaves (insulation at ceiling level)	24.3500	0.0600	1.4610

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 20.2775 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 153.6744 (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	138.7644	138.1518	137.5514	134.7313	134.2036	131.7474	131.7474	131.2925	132.6935	134.2036	135.2710	136.3870	(38)
Heat transfer coeff	292.4387	291.8262	291.2258	288.4056	287.8780	285.4218	285.4218	284.9669	286.3679	287.8780	288.9454	290.0613	(39)
Average = Sum(39)m / 12 =												288.4031	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0809	1.0786	1.0764	1.0660	1.0640	1.0549	1.0549	1.0532	1.0584	1.0640	1.0680	1.0721	(40)
HLP (average)												1.0659	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.0904	74.9469	73.2806	70.0924	67.7397	65.1159	63.6245	65.2782	67.0909	69.9081	73.1647	75.7988	(42a)
Hot water usage for baths	32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)
Hot water usage for other uses	46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)
Average daily hot water use (litres/day)												142.7068	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	155.2471	151.9317	147.8944	141.7557	136.7705	131.4110	129.3516	133.3715	137.6110	143.2375	149.4708	154.8445	(44)
Energy conte	245.8734	216.3488	227.3083	194.0565	184.1194	161.5852	156.4396	165.1418	169.6881	194.3719	212.9485	242.4491	(45)
Energy content (annual)										Total = Sum(45)m =		2370.3305	
Distribution loss (46)m = 0.15 x (45)m	36.8810	32.4523	34.0962	29.1085	27.6179	24.2378	23.4659	24.7713	25.4532	29.1558	31.9423	36.3674	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.5234	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.3626	(55)
Total storage loss	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(56)
If cylinder contains dedicated solar storage	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	311.3775	275.5138	292.8124	257.4475	249.6235	224.9763	221.9437	230.6459	233.0792	259.8760	276.3396	307.9532	(62)
WWHRS	-34.7853	-30.7644	-32.2147	-26.6751	-24.8602	-21.2731	-19.9401	-21.2043	-22.0099	-25.9473	-29.3951	-34.1412	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	276.5922	244.7493	260.5976	230.7725	224.7632	203.7032	202.0036	209.4416	211.0693	233.9287	246.9445	273.8120	(64)
										Total per year (kWh/year) = Sum(64)m =		2818.3778	(64)
12Total per year (kWh/year)												2818	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	134.1562	119.2680	127.9833	115.2366	113.6230	104.4399	104.4195	107.3129	107.1342	117.0320	121.5183	133.0176	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)

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

	227.4242	251.7911	227.4242	235.0050	227.4242	235.0050	227.4242	227.4242	235.0050	227.4242	235.0050	227.4242	(67)

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

	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)

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

	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)

Water heating gains (Table 5)

	180.3175	177.4821	172.0206	160.0509	152.7191	145.0555	140.3487	144.2378	148.7975	157.3010	168.7754	178.7871	(72)

Total internal gains

	914.1100	940.1447	898.9684	870.4213	825.0131	793.2689	761.8337	761.2196	784.7079	812.7890	862.3396	893.4320	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.6300	0.7000	0.7700	22.6179	(74)
East	15.6500	19.6403	0.6300	0.7000	0.7700	93.9363	(76)
West	21.6000	19.6403	0.6300	0.7000	0.7700	129.6501	(80)

Solar gains	246.2043	480.6065	793.7548	1168.5009	1446.3822	1488.0755	1413.5759	1203.8187	926.0549	570.4437	306.6881	202.7220	(83)
Total gains	1160.3144	1420.7512	1692.7232	2038.9221	2271.3953	2281.3444	2175.4096	1965.0383	1710.7629	1383.2327	1169.0277	1096.1541	(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	26.9433	26.9998	27.0555	27.3201	27.3701	27.6057	27.6057	27.6497	27.5145	27.3701	27.2690	27.1641	
alpha	2.7962	2.8000	2.8037	2.8213	2.8247	2.8404	2.8404	2.8433	2.8343	2.8247	2.8179	2.8109	
util living area	0.9862	0.9752	0.9524	0.8953	0.7959	0.6529	0.5190	0.5781	0.7899	0.9359	0.9779	0.9883	(86)
MIT	18.1961	18.5140	19.0394	19.7456	20.3442	20.7448	20.9040	20.8676	20.5280	19.7183	18.8360	18.1497	(87)
Th 2	20.0165	20.0183	20.0202	20.0287	20.0303	20.0378	20.0378	20.0392	20.0349	20.0303	20.0271	20.0237	(88)
util rest of house	0.9840	0.9712	0.9443	0.8768	0.7582	0.5860	0.4240	0.4835	0.7368	0.9210	0.9737	0.9863	(89)
MIT 2	16.6928	17.0987	17.7661	18.6537	19.3762	19.8289	19.9806	19.9547	19.6091	18.6359	17.5172	16.6375	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.0034	17.3911	18.0293	18.8793	19.5763	20.0182	20.1714	20.1433	19.7990	18.8596	17.7897	16.9500	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0034	17.3911	18.0293	18.8793	19.5763	20.0182	20.1714	20.1433	19.7990	18.8596	17.7897	16.9500	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9551	0.9215	0.8494	0.7379	0.5845	0.4380	0.4945	0.7215	0.8964	0.9588	0.9767	(94)
Useful gains	1129.1203	1356.9959	1559.8817	1731.8826	1676.0396	1333.5160	952.8428	971.8009	1234.3755	1239.9353	1120.8325	1070.6327	(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	3714.9702	3645.2385	3357.6158	2878.0923	2267.4025	1546.4685	1019.3671	1066.7163	1632.0045	2377.7449	3088.7354	3698.2745	(97)
Space heating kWh	1923.8723	1537.6991	1337.5141	825.2710	439.9740	0.0000	0.0000	0.0000	0.0000	846.5303	1416.8900	1954.9655	(98a)
Space heating requirement - total per year (kWh/year)												10282.7163	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1923.8723	1537.6991	1337.5141	825.2710	439.9740	0.0000	0.0000	0.0000	0.0000	846.5303	1416.8900	1954.9655	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10282.7163	
Space heating per m2											(98c) / (4) =	38.0053	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1923.8723	1537.6991	1337.5141	825.2710	439.9740	0.0000	0.0000	0.0000	0.0000	846.5303	1416.8900	1954.9655	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	2084.3687	1665.9795	1449.0944	894.1181	476.6782	0.0000	0.0000	0.0000	0.0000	917.1509	1535.0921	2118.0558	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	276.5922	244.7493	260.5976	230.7725	224.7632	203.7032	202.0036	209.4416	211.0693	233.9287	246.9445	273.8120 (64)
Efficiency of water heater												79.8000 (216)
(217)m	87.5587	87.4458	87.1964	86.6641	85.5381	79.8000	79.8000	79.8000	79.8000	86.6833	87.3381	87.5864 (217)
Fuel for water heating, kWh/month												
	315.8933	279.8869	298.8629	266.2838	262.7640	255.2672	253.1374	262.4581	264.4978	269.8658	282.7456	312.6192 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	47.2543	37.9091	34.1330	25.0073	19.3163	15.7816	17.6210	22.9045	29.7506	39.0344	44.0893	48.5676 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-108.0094	-143.6984	-194.9171	-206.2027	-211.7181	-193.5644	-190.7561	-184.8679	-173.5443	-157.4567	-115.4602	-94.3801 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-90.0672	-185.1734	-360.5954	-531.3479	-693.2165	-693.5115	-685.7079	-585.1162	-434.7536	-261.7322	-119.1635	-71.5923 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year		
Space heating fuel - main system 1	11140.5377	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3324.2821	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	381.3689	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6686.5529	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	8245.6358	(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	11140.5377	0.2100	2339.5129	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3324.2821	0.2100	698.0992	(264)
Space and water heating			3037.6122	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	381.3689	0.1443	55.0433	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1974.5754	0.1359	-268.3652	
PV Unit electricity exported	-4711.9775	0.1265	-595.8589	
Total			-864.2241	(269)
Total CO2, kg/year			2240.3607	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.2800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	11140.5377	1.1300	12588.8076	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3324.2821	1.1300	3756.4388	(278)
Space and water heating			16345.2464	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	381.3689	1.5338	584.9564	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1974.5754	1.5024	-2966.5515	
PV Unit electricity exported	-4711.9775	0.4642	-2187.3242	
Total			-5153.8758	(283)
Total Primary energy kWh/year			11906.4278	(286)
Target Primary Energy Rate (TPER)			44.0100	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 270.5600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2537	(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) =	0.2346	(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	0.2992	0.2933	0.2874	0.2581	0.2522	0.2229	0.2229	0.2170	0.2346	0.2522	0.2640	0.2757	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5447	0.5430	0.5413	0.5333	0.5318	0.5248	0.5248	0.5236	0.5275	0.5318	0.5348	0.5380	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28365.3320	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		104.8393	(35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126
E3	Sill	27.3000	0.0450	1.2285
E4	Jamb	64.4000	0.0510	3.2844
E5	Ground floor (normal)	54.9200	0.0640	3.5149
E6	Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16	Corner (normal)	38.5700	0.0570	2.1985
E17	Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13	Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11	Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6	Flat ceiling	3.4200	0.1200	0.4104
E12	Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10	Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.1558	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	147.7410	(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	133.9973	133.5698	133.1509	131.1830	130.8148	129.1008	129.1008	128.7834	129.7610	130.8148	131.5596	132.3383	(38)
Heat transfer coeff	281.7383	281.3109	280.8919	278.9240	278.5558	276.8419	276.8419	276.5245	277.5021	278.5558	279.3007	280.0794	(39)
Average = Sum(39)m / 12 =												278.9223	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0413	1.0397	1.0382	1.0309	1.0296	1.0232	1.0232	1.0220	1.0257	1.0296	1.0323	1.0352	(40)
HLP (average)												1.0309	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0937	(42)
Hot water usage for mixer showers	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(42a)
Hot water usage for baths	32.8446 32.3568 31.6699 30.4033 29.4550 28.4034 27.8354 28.5175 29.2602 30.3854 31.6780 32.7335		(42b)
Hot water usage for other uses	46.3122 44.6281 42.9440 41.2599 39.5758 37.8918 37.8918 39.5758 41.2599 42.9440 44.6281 46.3122		(42c)
Average daily hot water use (litres/day)		72.5540	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	79.1567	76.9849	74.6139	71.6633	69.0308	66.2951	65.7271	68.0933	70.5201	73.3294	76.3061	79.0457	(44)
Energy conte	125.3649	109.6254	114.6787	98.1034	92.9287	81.5176	79.4913	84.3137	86.9583	99.5073	108.7120	123.7664	(45)
Energy content (annual)											Total = Sum(45)m =	1204.9678	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(64)
										Total per year (kWh/year) = Sum(64)m =		1024.2226	(64)
12Total per year (kWh/year)												1024	(64)
Electric shower(s)													
	60.9357	54.2942	59.2872	56.5770	57.6387	54.9817	56.8144	57.6387	56.5770	59.2872	58.1724	60.9357	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					693.1400	(64a)
Heat gains from water heating, kWh/month													
	41.8740	36.8690	39.1910	34.9912	34.1570	31.0679	31.0955	32.3263	32.6229	35.9671	37.6444	41.5343	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	227.4242	251.7911	227.4242	235.0050	227.4242	235.0050	227.4242	227.4242	235.0050	227.4242	235.0050	227.4242	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	56.2822	54.8645	52.6761	48.5989	45.9100	43.1499	41.7950	43.4494	45.3096	48.3429	52.2839	55.8257	(72)
Total internal gains													
	787.0747	814.5271	776.6240	755.9693	715.2041	691.3633	663.2800	660.4312	681.2201	700.8308	742.8481	767.4706	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1068.4511	1363.7917	1683.7723	2091.3989	2368.2123	2392.0210	2278.7953	2036.2240	1739.5685	1352.7665	1093.3488	999.1529	(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	27.9666	28.0091	28.0509	28.2488	28.2861	28.4612	28.4612	28.4939	28.3935	28.2861	28.2107	28.1322	
alpha	2.8644	2.8673	2.8701	2.8833	2.8857	2.8974	2.8974	2.8996	2.8929	2.8857	2.8807	2.8755	
util living area													
	0.9889	0.9774	0.9519	0.8866	0.7750	0.6240	0.4902	0.5534	0.7776	0.9376	0.9812	0.9908	(86)
MIT	18.2265	18.5690	19.1202	19.8397	20.4235	20.7864	20.9226	20.8889	20.5704	19.7568	18.8575	18.1695	(87)
Th 2	20.0490	20.0504	20.0516	20.0577	20.0588	20.0640	20.0640	20.0650	20.0620	20.0588	20.0565	20.0541	(88)
util rest of house													
	0.9871	0.9738	0.9440	0.8674	0.7363	0.5584	0.4003	0.4623	0.7242	0.9232	0.9776	0.9893	(89)
MIT 2	17.4777	17.8187	18.3643	19.0673	19.6125	19.9286	20.0282	20.0099	19.7603	19.0008	18.1119	17.4243	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6324	17.9738	18.5205	19.2269	19.7801	20.1058	20.2130	20.1915	19.9277	19.1570	18.2660	17.5783	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6324	17.9738	18.5205	19.2269	19.7801	20.1058	20.2130	20.1915	19.9277	19.1570	18.2660	17.5783	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9803	0.9626	0.9270	0.8470	0.7235	0.5615	0.4153	0.4755	0.7154	0.9052	0.9677	0.9835	(94)
Useful gains	1047.4232	1312.7809	1560.8671	1771.4568	1713.3303	1343.1221	946.4211	968.2000	1244.5460	1224.4764	1058.0751	982.6764	(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													
	3756.2556	3677.7904	3376.4642	2880.4218	2250.7562	1524.2422	1000.2355	1048.4420	1617.2051	2383.6112	3118.6684	3746.9924	(97)
Space heating kWh													
	2015.3713	1589.2863	1350.8043	798.4548	399.8449	0.0000	0.0000	0.0000	0.0000	862.3962	1483.6272	2056.6511	(98a)
Space heating requirement - total per year (kWh/year)												10556.4360	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2015.3713	1589.2863	1350.8043	798.4548	399.8449	0.0000	0.0000	0.0000	0.0000	862.3962	1483.6272	2056.6511	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10556.4360	

Space heating per m2 (98c) / (4) = 39.0170 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2602.3135	2048.6298	2101.5859	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7546	0.8189	0.7724	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1963.6786	1677.6321	1623.2377	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2682.4987	2554.6507	2275.8357	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	517.5505	652.5019	485.5330	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	129.3876	163.1255	121.3832	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 413.8963 (107)
Energy for space heating 39.0170 (99)
Energy for space cooling 1.5298 (108)
Total 40.5468 (109)
Fabric Energy Efficiency (DFEE) 40.5 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b) =	342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c) =	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		745.3928	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3037 (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) =	0.2809 (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	0.3581	0.3511	0.3441	0.3090	0.3020	0.2668	0.2668	0.2598	0.2809	0.3020	0.3160	0.3300	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545	(25)

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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 Semi-glazed door			4.4800	1.0000	4.4800			(26a)
TER Opening Type (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1300	17.6150			(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133			(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1800	10.4922			(29a)
External Roof 1	5.1300		5.1300	0.1100	0.5643			(30)
External Roof 3	131.0000		131.0000	0.1100	14.4100			(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	133.3969			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 104.8393 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	29.4300	0.0500	1.4715	
E3 Sill	27.3000	0.0500	1.3650	
E4 Jamb	64.4000	0.0500	3.2200	
E5 Ground floor (normal)	54.9200	0.1600	8.7872	
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000	
E16 Corner (normal)	38.5700	0.0900	3.4713	
E17 Corner (inverted - internal area greater than external area)	16.5300	-0.0900	-1.4877	
E13 Gable (insulation at rafter level)	1.0000	0.0800	0.0800	
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568	
R6 Flat ceiling	3.4200	0.0600	0.2052	
E12 Gable (insulation at ceiling level)	24.1198	0.0600	1.4472	
E10 Eaves (insulation at ceiling level)	24.3500	0.0600	1.4610	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 20.2775 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 153.6744 (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	138.7644	138.1518	137.5514	134.7313	134.2036	131.7474	131.7474	131.2925	132.6935	134.2036	135.2710	136.3870	(38)
Heat transfer coeff	292.4387	291.8262	291.2258	288.4056	287.8780	285.4218	285.4218	284.9669	286.3679	287.8780	288.9454	290.0613	(39)
Average = Sum(39)m / 12 =												288.4031	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0809	1.0786	1.0764	1.0660	1.0640	1.0549	1.0549	1.0532	1.0584	1.0640	1.0680	1.0721	(40)
HLP (average)												1.0659	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 72.5540 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	79.1567	76.9849	74.6139	71.6633	69.0308	66.2951	65.7271	68.0933	70.5201	73.3294	76.3061	79.0457	(44)
Energy conte	125.3649	109.6254	114.6787	98.1034	92.9287	81.5176	79.4913	84.3137	86.9583	99.5073	108.7120	123.7664	(45)
Energy content (annual)										Total = Sum(45)m =		1204.9678	

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(64)
									Total per year (kWh/year) = Sum(64)m =		1024.2226	(64)
12Total per year (kWh/year)											1024	(64)

Electric shower(s)

60.9357	54.2942	59.2872	56.5770	57.6387	54.9817	56.8144	57.6387	56.5770	59.2872	58.1724	60.9357	(64a)
				Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							693.1400	(64a)

Heat gains from water heating, kWh/month

41.8740	36.8690	39.1910	34.9912	34.1570	31.0679	31.0955	32.3263	32.6229	35.9671	37.6444	41.5343	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	227.4242	251.7911	227.4242	235.0050	227.4242	235.0050	227.4242	227.4242	235.0050	227.4242	235.0050	227.4242	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	56.2822	54.8645	52.6761	48.5989	45.9100	43.1499	41.7950	43.4494	45.3096	48.3429	52.2839	55.8257	(72)
Total internal gains	787.0747	814.5271	776.6240	755.9693	715.2041	691.3633	663.2800	660.4312	681.2201	700.8308	742.8481	767.4706	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.6300	0.7000	0.7700	22.6179	(74)
East	15.6500	19.6403	0.6300	0.7000	0.7700	93.9363	(76)
West	21.6000	19.6403	0.6300	0.7000	0.7700	129.6501	(80)

Solar gains	246.2043	480.6065	793.7548	1168.5009	1446.3822	1488.0755	1413.5759	1203.8187	926.0549	570.4437	306.6881	202.7220	(83)
Total gains	1033.2791	1295.1336	1570.3788	1924.4702	2161.5863	2179.4388	2076.8559	1864.2499	1607.2750	1271.2745	1049.5362	970.1926	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	26.9433	26.9998	27.0555	27.3201	27.3701	27.6057	27.6057	27.6497	27.5145	27.3701	27.2690	27.1641	
alpha	2.7962	2.8000	2.8037	2.8213	2.8247	2.8404	2.8404	2.8433	2.8343	2.8247	2.8179	2.8109	
util living area	0.9897	0.9802	0.9598	0.9067	0.8117	0.6713	0.5377	0.5998	0.8100	0.9468	0.9831	0.9914	(86)
MIT	18.1048	18.4269	18.9607	19.6850	20.3040	20.7249	20.8948	20.8541	20.4907	19.6497	18.7520	18.0583	(87)
Th 2	20.0165	20.0183	20.0202	20.0287	20.0303	20.0378	20.0378	20.0392	20.0349	20.0303	20.0271	20.0237	(88)
util rest of house	0.9880	0.9769	0.9529	0.8898	0.7756	0.6049	0.4411	0.5042	0.7595	0.9340	0.9797	0.9900	(89)
MIT 2	17.3357	17.6570	18.1870	18.9003	19.4861	19.8609	19.9885	19.9657	19.6730	18.8783	17.9882	17.2940	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	17.4946	17.8161	18.3469	19.0625	19.6551	20.0394	20.1758	20.1493	19.8420	19.0377	18.1461	17.4519	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4946	17.8161	18.3469	19.0625	19.6551	20.0394	20.1758	20.1493	19.8420	19.0377	18.1461	17.4519	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9664	0.9369	0.8689	0.7595	0.6050	0.4559	0.5162	0.7476	0.9164	0.9704	0.9843	(94)
Useful gains	1014.1474	1251.6815	1471.2494	1672.2478	1641.6705	1318.5045	946.7837	962.2478	1201.5323	1165.0398	1018.4224	954.9827	(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	3858.6146	3769.2602	3450.1091	2930.9121	2290.0955	1552.5315	1020.6005	1068.4314	1644.3217	2429.0397	3191.7147	3843.8766	(97)
Space heating kWh	2116.2836	1691.8129	1472.2716	906.2383	482.4282	0.0000	0.0000	0.0000	0.0000	940.4159	1564.7705	2149.3371	(98a)

Space heating requirement - total per year (kWh/year) 11323.5580

Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh	2116.2836	1691.8129	1472.2716	906.2383	482.4282	0.0000	0.0000	0.0000	0.0000	940.4159	1564.7705	2149.3371	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 11323.5580

Space heating per m2 (98c) / (4) = 41.8523 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2682.9646	2112.1210	2165.7485	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7026	0.7730	0.7237	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1885.0722	1632.7737	1567.4420	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2434.0260	2318.6177	2074.8270	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	395.2467	510.2679	377.4945	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	98.8117	127.5670	94.3736	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 320.7523 (107)

Energy for space heating 41.8523 (99)

Energy for space cooling 1.1855 (108)

Total 43.0378 (109)

Fabric Energy Efficiency (TFEE) 43.0 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b)	= 342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c)	= 403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 745.3928	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3073 (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) =	0.2843 (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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(25)

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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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28365.3320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		104.8393 (35)

List of Thermal Bridges

	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126
E3 Sill	27.3000	0.0450	1.2285
E4 Jamb	64.4000	0.0510	3.2844
E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.1558 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	147.7410 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.8882	286.2608	285.6458	282.7573	282.2168	279.7010	279.7010	279.2351	280.6700	282.2168	283.3101	284.4531	(39)
Average = Sum(39)m / 12 =												282.7547	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0603	1.0580	1.0558	1.0451	1.0431	1.0338	1.0338	1.0321	1.0374	1.0431	1.0471	1.0513	(40)
HLP (average)												1.0451	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0937 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day)	169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	
Distribution loss (46)m = 0.15 x (45)m	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:	
Store volume	400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.2000 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.1880 (55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)

WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
									Total per year (kWh/year) = Sum(64)m =			3514.8575	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
								Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =				0.0000	(64a)
Heat gains from water heating, kWh/month													
	144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.8833	46.9704	38.1989	28.9190	21.6173	18.2503	19.7200	25.6329	34.4044	43.6843	50.9860	54.3530	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains													
	1013.8111	1011.3901	979.2934	919.7279	858.2446	803.0188	770.2332	773.9642	805.0133	860.4254	926.8701	984.8660	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1295.1875	1560.6547	1886.4418	2255.1575	2511.2528	2503.6765	2385.7485	2149.7570	1863.3618	1512.3611	1277.3708	1216.5483	(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	27.4646	27.5248	27.5840	27.8658	27.9192	28.1703	28.1703	28.2173	28.0730	27.9192	27.8114	27.6997	
alpha	2.8310	2.8350	2.8389	2.8577	2.8613	2.8780	2.8780	2.8812	2.8715	2.8613	2.8541	2.8466	
util living area													
	0.9819	0.9688	0.9386	0.8705	0.7571	0.6084	0.4756	0.5344	0.7558	0.9212	0.9725	0.9848	(86)
Living	18.8984	19.1364	19.5468	20.0623	20.4807	20.7408	20.8385	20.8159	20.5916	20.0142	19.3586	18.8578	
Non living	17.5355	17.8392	18.3590	19.0048	19.5039	19.7953	19.8862	19.8713	19.6468	18.9599	18.1310	17.4887	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9249	19.1364	19.5468	20.0623	20.4807	20.7408	20.8385	20.8159	20.5916	20.0142	19.3586	19.1574	(87)
Th 2	20.0333	20.0353	20.0371	20.0459	20.0476	20.0553	20.0553	20.0567	20.0523	20.0476	20.0442	20.0408	(88)
util rest of house													
	0.9790	0.9639	0.9287	0.8493	0.7169	0.5424	0.3866	0.4441	0.7000	0.9038	0.9673	0.9823	(89)
MIT 2	19.0375	17.8392	18.3590	19.0048	19.5039	19.7953	19.8862	19.8713	19.6468	18.9599	18.1310	17.9486	(90)
Living area fraction											fLA = Living area / (4) =	0.2066	(91)
MIT	19.2209	18.1073	18.6045	19.2234	19.7057	19.9907	20.0830	20.0665	19.8421	19.1778	18.3847	18.1984	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2209	18.1073	18.6045	19.2234	19.7057	19.9907	20.0830	20.0665	19.8421	19.1778	18.3847	18.1984	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9505	0.9098	0.8274	0.7007	0.5375	0.3894	0.4451	0.6857	0.8834	0.9549	0.9760	(94)
Useful gains	1264.2459	1483.4673	1716.3345	1865.9761	1759.5817	1345.7592	929.0227	956.7881	1277.7654	1335.9639	1219.7644	1187.3440	(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													
	4280.6295	3780.7290	3457.5925	2919.0046	2259.3481	1507.7870	974.1999	1023.8144	1611.6223	2420.8009	3197.0559	3981.8811	(97)
Space heating kWh													
	2244.1894	1543.7599	1295.4959	758.1805	371.8262	0.0000	0.0000	0.0000	0.0000	807.1187	1423.6499	2079.1356	(98a)
Space heating requirement - total per year (kWh/year)												10523.3561	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2244.1894	1543.7599	1295.4959	758.1805	371.8262	0.0000	0.0000	0.0000	0.0000	807.1187	1423.6499	2079.1356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10523.3561	
Space heating per m2											(98c) / (4) =	38.8947	(99)

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 %)	299.9213	(206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2244.1894	1543.7599	1295.4959	758.1805	371.8262	0.0000	0.0000	0.0000	0.0000	807.1187	1423.6499	2079.1356	(98)
Space heating efficiency (main heating system 1)													
	299.9213	299.9213	299.9213	299.9213	299.9213	0.0000	0.0000	0.0000	0.0000	299.9213	299.9213	299.9213	(210)
Space heating fuel (main heating system)													
	748.2595	514.7217	431.9453	252.7932	123.9746	0.0000	0.0000	0.0000	0.0000	269.1102	474.6745	693.2271	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8292	(216)
(217)m	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	(217)
Fuel for water heating, kWh/month													
	209.2332	185.0960	196.4108	171.7167	165.8866	148.8195	146.2115	152.2635	154.2424	172.8165	184.8243	206.7849	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	46.2884	37.1343	33.4353	24.4961	18.9215	15.4590	17.2608	22.4363	29.1425	38.2366	43.1881	47.5749	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.7307	-27.9883	-44.9549	-55.9988	-64.6003	-60.2437	-59.4044	-53.5134	-44.0596	-33.9030	-20.3908	-14.9510	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.3039	-5.4437	-11.9836	-20.3100	-29.6728	-32.4418	-32.0562	-26.3962	-18.5256	-8.8354	-3.3731	-1.8146	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 3508.7061 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 167.8292
Water heating fuel used 2094.3060 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 0.0000 (231)
Electricity for lighting (calculated in Appendix L) 373.5739 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 5285.6904 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2806.9649	17.5600	550.1651	(240)
Space heating - main system 1 (low-rate cost)	701.7412	0.0940	65.9637	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1466.0142	19.6000	287.3388	(245)
Low-rate cost	628.2918	9.4000	59.0594	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	373.5739	18.5800	69.4100	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.7388	18.5800	-92.4799	
PV Unit electricity exported	-193.1569	5.5900	-10.7975	
Total			-103.2773	(252)
Total energy cost			935.6597	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.0674 (257)
SAP value 82.6970
SAP rating (Section 12) 83 (258)
SAP band B

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 (high-rate cost)	2806.9649	0.1627	456.8156	(261)

Space heating - main system 1 (low-rate cost)	701.7412	0.1366	95.8744	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.0142	0.1479	216.8891	(264)
Water heating - low rate cost	628.2918	0.1242	78.0129	(264)
Space and water heating			847.5920	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	373.5739	0.1490	55.6699	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.7388	0.1371	-68.2324	
PV Unit electricity exported	-193.1569	0.1219	-23.5457	
Total			-91.7781	(269)
Total CO2, kg/year			811.4838	(272)
CO2 emissions per m2			3.0000	(273)
EI value			96.5541	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b) =	342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c) =	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		745.3928	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	6 * 10 =	60.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3073	(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) =	0.2843	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2985	0.2843	0.2843	0.2630	0.2630	0.2345	0.2416	0.2274	0.2345	0.2487	0.2487	0.2701	(22b)
Effective ac	0.5445	0.5404	0.5404	0.5346	0.5346	0.5275	0.5292	0.5259	0.5275	0.5309	0.5309	0.5365	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28365.3320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		104.8393 (35)

List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E1	Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126
E3	Sill	27.3000	0.0450	1.2285
E4	Jamb	64.4000	0.0510	3.2844
E5	Ground floor (normal)	54.9200	0.0640	3.5149
E6	Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16	Corner (normal)	38.5700	0.0570	2.1985

E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430	
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100	
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568	
R6 Flat ceiling	3.4200	0.1200	0.4104	
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607	
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.1558 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.7410 (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	133.9478	132.9290	132.9290	131.4940	131.4940	129.7547	130.1709	129.3509	129.7547	130.5995	130.5995	131.9599	(38)
Heat transfer coeff	281.6888	280.6700	280.6700	279.2351	279.2351	277.4957	277.9119	277.0919	277.4957	278.3405	278.3405	279.7010	(39)
Average = Sum(39)m / 12 =												278.9897	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0411	1.0374	1.0374	1.0321	1.0321	1.0256	1.0272	1.0241	1.0256	1.0288	1.0288	1.0338	(40)
HLP (average)												1.0312	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)
Hot water usage for mixer showers

104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	
Distribution loss (46)m = 0.15 x (45)m	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:
Store volume 400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.2000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1880 (55)
Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
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)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)

Total per year (kWh/year) = Sum(64)m = 3514.8575 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.8833	46.9704	38.1989	28.9190	21.6173	18.2503	19.7200	25.6329	34.4044	43.6843	50.9860	54.3530	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains	1013.8111	1011.3901	979.2934	919.7279	858.2446	803.0188	770.2332	773.9642	805.0133	860.4254	926.8701	984.8660	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	11.9814	0.7200	0.7000	0.7700	29.1261	(74)
East	15.6500	22.3313	0.7200	0.7000	0.7700	122.0654	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	319.6650	561.7771	915.8645	1386.6530	1669.2059	1836.3868	1726.1676	1505.4580	1157.3892	711.8749	408.0325	260.5938	(83)
Total gains	1333.4761	1573.1672	1895.1580	2306.3810	2527.4505	2639.4055	2496.4008	2279.4221	1962.4025	1572.3003	1334.9026	1245.4598	(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	27.9715	28.0730	28.0730	28.2173	28.2173	28.3942	28.3516	28.4355	28.3942	28.3080	28.3080	28.1703	
alpha	2.8648	2.8715	2.8715	2.8812	2.8812	2.8929	2.8901	2.8957	2.8929	2.8872	2.8872	2.8780	
util living area	0.9780	0.9644	0.9278	0.8400	0.6949	0.4834	0.3345	0.3732	0.6656	0.8936	0.9638	0.9814	(86)
Living	19.0827	19.2916	19.7177	20.2288	20.6204	20.8300	20.8787	20.8733	20.7201	20.2000	19.5584	19.0498	
Non living	17.7814	18.0483	18.5851	19.2154	19.6689	19.8839	19.9190	19.9193	19.7892	19.1972	18.3950	17.7439	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0192	19.2916	19.7177	20.2288	20.6204	20.8300	20.8787	20.8733	20.7201	20.2000	19.5584	19.3226	(87)
Th 2	20.0492	20.0523	20.0523	20.0567	20.0567	20.0620	20.0608	20.0633	20.0620	20.0594	20.0594	20.0553	(88)
util rest of house	0.9743	0.9586	0.9158	0.8134	0.6443	0.4054	0.2376	0.2703	0.5928	0.8693	0.9568	0.9783	(89)
MIT 2	19.1451	18.0483	18.5851	19.2154	19.6689	19.8839	19.9190	19.9193	19.7892	19.1972	18.3950	18.1604	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.3257	18.3052	18.8191	19.4248	19.8655	20.0794	20.1173	20.1164	19.9816	19.4044	18.6354	18.4006	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3257	18.3052	18.8191	19.4248	19.8655	20.0794	20.1173	20.1164	19.9816	19.4044	18.6354	18.4006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9711	0.9444	0.8960	0.7926	0.6330	0.4069	0.2436	0.2764	0.5859	0.8482	0.9423	0.9711	(94)
Useful gains	1294.8810	1485.6331	1698.0623	1828.1356	1599.7676	1074.0203	608.0515	630.0271	1149.7521	1333.5557	1257.8931	1209.4153	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4007.2289	3565.9755	3205.0052	2659.6594	1917.0995	1132.0111	616.2278	641.8629	1326.8680	2172.2783	2960.2714	3720.1798	(97)
Space heating kWh	2017.9868	1397.9902	1121.1655	598.6972	236.0949	0.0000	0.0000	0.0000	0.0000	624.0096	1225.7124	1868.0087	(98a)
Space heating requirement - total per year (kWh/year)												9089.6652	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2017.9868	1397.9902	1121.1655	598.6972	236.0949	0.0000	0.0000	0.0000	0.0000	624.0096	1225.7124	1868.0087	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9089.6652	
Space heating per m2											(98c) / (4) =	33.5957	(99)

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 %) 299.6832 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2017.9868	1397.9902	1121.1655	598.6972	236.0949	0.0000	0.0000	0.0000	0.0000	624.0096	1225.7124	1868.0087	(98)
Space heating efficiency (main heating system 1)	299.6832	299.6832	299.6832	299.6832	299.6832	0.0000	0.0000	0.0000	0.0000	299.6832	299.6832	299.6832	(210)
Space heating fuel (main heating system)	673.3734	466.4893	374.1169	199.7767	78.7815	0.0000	0.0000	0.0000	0.0000	208.2231	409.0027	623.3278	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8186	(216)
(217)m	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	(217)
Fuel for water heating, kWh/month	209.2464	185.1077	196.4232	171.7276	165.8971	148.8288	146.2207	152.2731	154.2521	172.8274	184.8360	206.7979	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	46.2884	37.1343	33.4353	24.4961	18.9215	15.4590	17.2608	22.4363	29.1425	38.2366	43.1881	47.5749	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.6680	-28.1356	-44.6360	-56.8901	-64.0974	-63.7037	-62.2834	-57.1358	-47.0118	-35.9447	-23.0546	-16.4416	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.7907	-5.6198	-12.2123	-21.6917	-30.5415	-35.8996	-34.9283	-29.6748	-20.7441	-10.1484	-4.2445	-2.1655	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1 3033.0913 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 167.8186

Water heating fuel used 2094.4382 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year 0.0000 (231)

Electricity for lighting (calculated in Appendix L) 373.5739 (232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-729.6639	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4771.4396	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2426.4731	26.7600	723.0890	(240)
Space heating - main system 1 (low-rate cost)	606.6183	0.1460	88.5663	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1466.1067	29.8000	436.8998	(245)
Low-rate cost	628.3314	14.6000	91.7364	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	373.5739	28.2800	105.6467	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.0026	28.2800	-146.7739	
PV Unit electricity exported	-210.6613	5.8100	-12.2394	
Total			-159.0134	(252)
Total energy cost			1290.9248	(255)

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 (high-rate cost)	2426.4731	0.1634	396.4605	(261)
Space heating - main system 1 (low-rate cost)	606.6183	0.1372	83.2054	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.1067	0.1479	216.9028	(264)
Water heating - low rate cost	628.3314	0.1242	78.0178	(264)
Space and water heating			774.5865	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	373.5739	0.1490	55.6699	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.0026	0.1370	-71.0969	
PV Unit electricity exported	-210.6613	0.1216	-25.6154	
Total			-96.7122	(269)
Total CO2, kg/year			733.5441	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2426.4731	1.2873	3904.3512	(275)
Space heating - main system 1 (low-rate cost)	606.6183	1.4965	907.8053	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1466.1067	1.5530	2276.8878	(278)
Water heating - low rate cost	628.3314	1.4444	907.5346	(278)
Space and water heating			7996.5789	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	373.5739	1.5547	580.8120	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.0026	1.5108	-784.1019	
PV Unit electricity exported	-210.6613	0.4460	-93.9560	
Total			-878.0579	(283)
Total Primary energy kWh/year			7699.3330	(286)

SAP 10 EPC IMPROVEMENTS

P2 Oakley

Current energy efficiency rating: B 83
Current environmental impact rating: A 97

N	Solar water heating	Recommended
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 93	-47 kg (6.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£93	0.17 kg/m²	B 84	A 97
Total Savings	£93	0.17 kg/m²		

Potential energy efficiency rating: B 84
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1450	£1355	£95
Space heating	£816	£839	-£23
Water heating	£529	£411	£118
Lighting	£106	£106	£0
Generated (PV)	-£159	-£158	-£1
Total cost of fuels	£1291	£1197	£94
Total cost of uses	£1292	£1198	£94
Delivered energy	18 kWh/m²	16 kWh/m²	1 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.7 tonnes	0.0 tonnes
CO2 emissions per m²	3 kg/m²	3 kg/m²	0 kg/m²
Primary energy	28 kWh/m²	26 kWh/m²	2 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3073 (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) =	0.2843 (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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28365.3320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		104.8393 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126
E3 Sill	27.3000	0.0450	1.2285
E4 Jamb	64.4000	0.0510	3.2844

E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.1558 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.7410 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.8882	286.2608	285.6458	282.7573	282.2168	279.7010	279.7010	279.2351	280.6700	282.2168	283.3101	284.4531	(39)

Average = Sum(39)m / 12 = 282.7547

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0603	1.0580	1.0558	1.0451	1.0431	1.0338	1.0338	1.0321	1.0374	1.0431	1.0471	1.0513	(40)
HLP (average)												1.0451	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)

Hot water usage for mixer showers

104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	
Distribution loss (46)m = 0.15 x (45)m	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:

Store volume	400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.2000	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1880	(55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)

Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

351.1545	310.6452	328.2390	281.4372	265.6119	237.1558	232.3587	243.4463	253.4609	288.6408	310.1893	347.0455	(62)

WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.8000 (H2)
Collector linear heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0000 (H4)
Collector loop efficiency	0.9000 (H5)
Incidence angle modifier	1.0000 (H6)
Overshading factor	0.8000 (H8)
Overall heat loss coefficient of system	6.5000 (H10)
Heat loss coefficient of collector loop	3.9667 (H11)
Dedicated solar storage volume	75.0000 (H12)
Effective solar volume	75.0000 (H14)
Reference volume	225.0000 (H15)
Storage tank correction coefficient	1.3161 (H16)
Heat delivered to hot water	655.6860 (H24)
Heat delivered to space heating	0.0000 (H29)
Solar input	655.6860

Solar input	-0.0000	-16.1617	-60.0148	-83.9564	-111.7401	-103.3699	-102.8046	-88.7423	-59.9735	-28.9228	-0.0000	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

351.1545	294.4835	268.2242	197.4808	153.8718	133.7859	129.5541	154.7040	193.4874	259.7180	310.1893	347.0455	(64)

Total per year (kWh/year) = Sum(64)m = 2793.6991 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

144.8511	128.6632	136.5792	117.6066	110.4269	100.1467	99.2614	103.3831	108.9360	123.4128	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.8833	46.9704	38.1989	28.9190	21.6173	18.2503	19.7200	25.6329	34.4044	43.6843	50.9860	54.3530	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	194.6924	191.4631	183.5742	163.3426	148.4232	139.0927	133.4159	138.9557	151.3000	165.8774	181.0055	192.8560	(72)
Total internal gains	1013.8111	1011.3901	977.7926	912.2239	844.4872	789.0113	756.2258	760.9572	799.0101	858.9246	926.8701	984.8660	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	10.6334	0.7200	0.7000	0.7700	25.8491	(74)
East	15.6500	19.6403	0.7200	0.7000	0.7700	107.3558	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	281.3764	549.2646	907.1483	1335.4296	1653.0082	1700.6577	1615.5153	1375.7928	1058.3485	651.9357	350.5007	231.6823	(83)
Total gains	1295.1875	1560.6547	1884.9410	2247.6535	2497.4955	2489.6690	2371.7411	2136.7500	1857.3586	1510.8603	1277.3708	1216.5483	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.4646	27.5248	27.5840	27.8658	27.9192	28.1703	28.1703	28.2173	28.0730	27.9192	27.8114	27.6997	
alpha	2.8310	2.8350	2.8389	2.8577	2.8613	2.8780	2.8780	2.8812	2.8715	2.8613	2.8541	2.8466	
util living area	0.9819	0.9688	0.9387	0.8713	0.7591	0.6107	0.4779	0.5369	0.7570	0.9214	0.9725	0.9848	(86)
Living	18.8984	19.1364	19.5461	20.0596	20.4776	20.7392	20.8378	20.8150	20.5902	20.0136	19.3586	18.8578	
Non living	17.5355	17.8392	18.3582	19.0017	19.5005	19.7940	19.8858	19.8706	19.6455	18.9592	18.1310	17.4887	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9249	19.1364	19.5461	20.0596	20.4776	20.7392	20.8378	20.8150	20.5902	20.0136	19.3586	19.1574	(87)
Th 2	20.0333	20.0353	20.0371	20.0459	20.0476	20.0553	20.0553	20.0567	20.0523	20.0476	20.0442	20.0408	(88)
util rest of house	0.9790	0.9639	0.9288	0.8502	0.7190	0.5447	0.3887	0.4463	0.7012	0.9040	0.9673	0.9823	(89)
MIT 2	19.0375	17.8392	18.3582	19.0017	19.5005	19.7940	19.8858	19.8706	19.6455	18.9592	18.1310	17.9486	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.2209	18.1073	18.6037	19.2203	19.7024	19.9893	20.0825	20.0658	19.8407	19.1771	18.3847	18.1984	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2209	18.1073	18.6037	19.2203	19.7024	19.9893	20.0825	20.0658	19.8407	19.1771	18.3847	18.1984	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9505	0.9100	0.8283	0.7027	0.5397	0.3914	0.4473	0.6869	0.8836	0.9549	0.9760	(94)
Useful gains	1264.2459	1483.4673	1715.2233	1861.7917	1754.9049	1343.6708	928.2871	955.7293	1275.8605	1334.9485	1219.7644	1187.3440	(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	4280.6295	3780.7290	3457.3600	2918.1370	2258.4125	1507.3912	974.0615	1023.6142	1611.2420	2420.5894	3197.0559	3981.8811	(97)
Space heating kWh	2244.1894	1543.7599	1296.1497	760.5686	374.6097	0.0000	0.0000	0.0000	0.0000	807.7168	1423.6499	2079.1356	(98a)
Space heating requirement - total per year (kWh/year)												10529.7795	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2244.1894	1543.7599	1296.1497	760.5686	374.6097	0.0000	0.0000	0.0000	0.0000	807.7168	1423.6499	2079.1356	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10529.7795	
Space heating per m2											(98c) / (4) =	38.9185	(99)

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 %)	299.9213	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2244.1894	1543.7599	1296.1497	760.5686	374.6097	0.0000	0.0000	0.0000	0.0000	807.7168	1423.6499	2079.1356	(98)
Space heating efficiency (main heating system 1)	299.9213	299.9213	299.9213	299.9213	299.9213	0.0000	0.0000	0.0000	0.0000	299.9213	299.9213	299.9213	(210)
Space heating fuel (main heating system)	748.2595	514.7217	432.1633	253.5894	124.9027	0.0000	0.0000	0.0000	0.0000	269.3096	474.6745	693.2271	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	351.1545	294.4835	268.2242	197.4808	153.8718	133.7859	129.5541	154.7040	193.4874	259.7180	310.1893	347.0455	(64)
Efficiency of water heater												167.8292	(216)
(217)m	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	167.8292	(217)
Fuel for water heating, kWh/month	209.2332	175.4662	159.8197	117.6677	91.6836	79.7155	77.1940	92.1794	115.2883	154.7514	184.8243	206.7849	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	46.2884	37.1343	33.4353	24.4961	18.9215	15.4590	17.2608	22.4363	29.1425	38.2366	43.1881	47.5749	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.7365	-27.9868	-44.8534	-55.6501	-63.7312	-59.0897	-58.2527	-52.7086	-43.7313	-33.8739	-20.4014	-14.9558	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-2.2981	-5.4452	-12.0851	-20.6587	-30.5419	-33.5957	-33.2080	-27.2010	-18.8540	-8.8645	-3.3625	-1.8098 (233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year		
Space heating fuel - main system 1	3510.8478	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.8292	
Water heating fuel used	1664.6083	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	373.5739	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4938.1343	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2808.6783	17.5600	550.5009	(240)
Space heating - main system 1 (low-rate cost)	702.1696	0.0940	66.0039	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1165.2258	19.6000	228.3843	(245)
Low-rate cost	499.3825	9.4000	46.9420	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	18.5800	14.8640	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	373.5739	18.5800	69.4100	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-492.9712	18.5800	-91.5940	
PV Unit electricity exported	-197.9246	5.5900	-11.0640	
Total			-102.6580	(252)
Total energy cost			880.4471	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0044	(257)
SAP value		83.7180	
SAP rating (Section 12)		84	(258)
SAP band		B	

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 (high-rate cost)	2808.6783	0.1627	457.0645	(261)
Space heating - main system 1 (low-rate cost)	702.1696	0.1366	95.9267	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1165.2258	0.1518	176.8290	(264)
Water heating - low rate cost	499.3825	0.1274	63.6071	(264)
Space and water heating			793.4272	(265)
Pumps, fans and electric keep-hot	80.0000	0.1432	11.4562	(267)
Energy for lighting	373.5739	0.1490	55.6699	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-492.9712	0.1372	-67.6366	
PV Unit electricity exported	-197.9246	0.1216	-24.0686	
Total			-91.7052	(269)
Total CO2, kg/year			768.8482	(272)
CO2 emissions per m2			2.8400	(273)
EI value			96.7351	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3073 (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) =	0.2843 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2985	0.2843	0.2843	0.2630	0.2630	0.2345	0.2416	0.2274	0.2345	0.2487	0.2487	0.2701	(22b)
Effective ac	0.5445	0.5404	0.5404	0.5346	0.5346	0.5275	0.5292	0.5259	0.5275	0.5309	0.5309	0.5365	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			44.2100	1.1450	50.6221			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	26.5300	195.6292	0.1800	35.2133	60.0000	11737.7520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		128.5852			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28365.3320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		104.8393 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	29.4300	0.0480	1.4126
E3 Sill	27.3000	0.0450	1.2285
E4 Jamb	64.4000	0.0510	3.2844
E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.1558 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	147.7410 (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	133.9478	132.9290	132.9290	131.4940	131.4940	129.7547	130.1709	129.3509	129.7547	130.5995	130.5995	131.9599	(38)
Heat transfer coeff	281.6888	280.6700	280.6700	279.2351	279.2351	277.4957	277.9119	277.0919	277.4957	278.3405	278.3405	279.7010	(39)
Average = Sum(39)m / 12 =												278.9897	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0411	1.0374	1.0374	1.0321	1.0321	1.0256	1.0272	1.0241	1.0256	1.0288	1.0288	1.0338	(40)
HLP (average)												1.0312	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0937 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

	46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122 (42c)
Average daily hot water use (litres/day)												169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)											Total = Sum(45)m =	2807.3415	
Distribution loss (46)m = 0.15 x (45)m													
	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	351.1545	310.6452	328.2390	281.4372	265.6119	237.1558	232.3587	243.4463	253.4609	288.6408	310.1893	347.0455	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												717.7642	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												717.7642	
Solar input	-0.0000	-17.5846	-61.0929	-88.7056	-113.9471	-114.2699	-112.1852	-100.5321	-69.3828	-36.1908	-3.8732	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	351.1545	293.0606	267.1461	192.7316	151.6648	122.8859	120.1735	142.9142	184.0782	252.4500	306.3161	347.0455	(64)
											Total per year (kWh/year) = Sum(64)m =	2731.6209	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	144.8511	128.6632	136.5792	117.6066	110.4269	100.1467	99.2614	103.3831	108.9360	123.4128	130.3240	143.4849	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.8833	46.9704	38.1989	28.9190	21.6173	18.2503	19.7200	25.6329	34.4044	43.6843	50.9860	54.3530	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	194.6924	191.4631	183.5742	163.3426	148.4232	139.0927	133.4159	138.9557	151.3000	165.8774	181.0055	192.8560	(72)
Total internal gains													
	1013.8111	1011.3901	977.7926	912.2239	844.4872	789.0113	756.2258	760.9572	799.0101	858.9246	926.8701	984.8660	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.9600	11.9814	0.7200	0.7000	0.7700	29.1261	(74)
East	15.6500	22.3313	0.7200	0.7000	0.7700	122.0654	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	319.6650	561.7771	915.8645	1386.6530	1669.2059	1836.3868	1726.1676	1505.4580	1157.3892	711.8749	408.0325	260.5938	(83)
Total gains	1333.4761	1573.1672	1893.6572	2298.8770	2513.6931	2625.3981	2482.3934	2266.4152	1956.3993	1570.7995	1334.9026	1245.4598	(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	27.9715	28.0730	28.0730	28.2173	28.2173	28.3942	28.3516	28.4355	28.3942	28.3080	28.3080	28.1703	
alpha	2.8648	2.8715	2.8715	2.8812	2.8812	2.8929	2.8901	2.8957	2.8929	2.8872	2.8872	2.8780	
util living area													
	0.9780	0.9644	0.9279	0.8409	0.6971	0.4855	0.3362	0.3751	0.6669	0.8938	0.9638	0.9814	(86)
Living	19.0827	19.2916	19.7170	20.2264	20.6180	20.8293	20.8785	20.8731	20.7192	20.1994	19.5584	19.0498	
Non living	17.7814	18.0483	18.5843	19.2126	19.6666	19.8834	19.9190	19.9192	19.7884	19.1965	18.3950	17.7439	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0192	19.2916	19.7170	20.2264	20.6180	20.8293	20.8785	20.8731	20.7192	20.1994	19.5584	19.3226	(87)
Th 2	20.0492	20.0523	20.0523	20.0567	20.0567	20.0620	20.0608	20.0633	20.0620	20.0594	20.0594	20.0553	(88)

util rest of house													
	0.9743	0.9586	0.9159	0.8144	0.6465	0.4073	0.2389	0.2718	0.5941	0.8695	0.9568	0.9783	(89)
MIT 2	19.1451	18.0483	18.5843	19.2126	19.6666	19.8834	19.9190	19.9192	19.7884	19.1965	18.3950	18.1604	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.3257	18.3052	18.8183	19.4221	19.8632	20.0788	20.1172	20.1163	19.9808	19.4037	18.6354	18.4006	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3257	18.3052	18.8183	19.4221	19.8632	20.0788	20.1172	20.1163	19.9808	19.4037	18.6354	18.4006	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9711	0.9444	0.8962	0.7936	0.6351	0.4088	0.2449	0.2779	0.5871	0.8484	0.9423	0.9711	(94)
Useful gains	1294.8810	1485.6331	1697.0036	1824.4648	1596.3553	1073.1804	607.9037	629.8153	1148.5870	1332.6589	1257.8931	1209.4153	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4007.2289	3565.9755	3204.7859	2658.9104	1916.4367	1131.8556	616.1981	641.8210	1326.6436	2172.0934	2960.2714	3720.1798	(97)
Space heating kWh													
	2017.9868	1397.9902	1121.7900	600.8008	238.1406	0.0000	0.0000	0.0000	0.0000	624.5393	1225.7124	1868.0087	(98a)
Space heating requirement - total per year (kWh/year)												9094.9688	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2017.9868	1397.9902	1121.7900	600.8008	238.1406	0.0000	0.0000	0.0000	0.0000	624.5393	1225.7124	1868.0087	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9094.9688	
Space heating per m2											(98c) / (4) =	33.6153	(99)

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 %)												299.6832	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2017.9868	1397.9902	1121.7900	600.8008	238.1406	0.0000	0.0000	0.0000	0.0000	624.5393	1225.7124	1868.0087	(98)
Space heating efficiency (main heating system 1)													
	299.6832	299.6832	299.6832	299.6832	299.6832	0.0000	0.0000	0.0000	0.0000	299.6832	299.6832	299.6832	(210)
Space heating fuel (main heating system)													
	673.3734	466.4893	374.3253	200.4786	79.4641	0.0000	0.0000	0.0000	0.0000	208.3998	409.0027	623.3278	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	351.1545	293.0606	267.1461	192.7316	151.6648	122.8859	120.1735	142.9142	184.0782	252.4500	306.3161	347.0455	(64)
Efficiency of water heater												167.8186	(216)
(217)m	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	167.8186	(217)
Fuel for water heating, kWh/month													
	209.2464	174.6294	159.1874	114.8452	90.3742	73.2254	71.6092	85.1599	109.6887	150.4303	182.5280	206.7979	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	46.2884	37.1343	33.4353	24.4961	18.9215	15.4590	17.2608	22.4363	29.1425	38.2366	43.1881	47.5749	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.6753	-28.1324	-44.5251	-56.4720	-63.1301	-62.2918	-60.9131	-56.1077	-46.5755	-35.8903	-23.0651	-16.4476	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.7834	-5.6229	-12.3232	-22.1098	-31.5088	-37.3115	-36.2985	-30.7029	-21.1805	-10.2029	-4.2340	-2.1595	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3034.8611	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												167.8186	
Water heating fuel used												1627.7221	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												373.5739	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-729.6639	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												4386.4932	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel	Fuel price	Fuel cost

	kWh/year	p/kWh	£/year	
Space heating - main system 1 (high-rate cost)	2427.8889	26.7600	723.5109	(240)
Space heating - main system 1 (low-rate cost)	606.9722	0.1460	88.6179	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1139.4055	29.8000	339.5428	(245)
Low-rate cost	488.3166	14.6000	71.2942	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	28.2800	22.6240	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	373.5739	28.2800	105.6467	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.2260	28.2800	-145.1403	
PV Unit electricity exported	-216.4379	5.8100	-12.5750	
Total			-157.7153	(252)
Total energy cost			1197.5212	(255)

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 (high-rate cost)	2427.8889	0.1634	396.6671	(261)
Space heating - main system 1 (low-rate cost)	606.9722	0.1372	83.2488	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1139.4055	0.1522	173.4462	(264)
Water heating - low rate cost	488.3166	0.1278	62.3910	(264)
Space and water heating			715.7531	(265)
Pumps, fans and electric keep-hot	80.0000	0.1432	11.4562	(267)
Energy for lighting	373.5739	0.1490	55.6699	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.2260	0.1371	-70.3762	
PV Unit electricity exported	-216.4379	0.1213	-26.2466	
Total			-96.6228	(269)
Total CO2, kg/year			686.2564	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2427.8889	1.2872	3906.5411	(275)
Space heating - main system 1 (low-rate cost)	606.9722	1.4965	908.3144	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1139.4055	1.5685	1787.1905	(278)
Water heating - low rate cost	488.3166	1.4588	712.3614	(278)
Space and water heating			7314.4075	(279)
Pumps, fans and electric keep-hot	80.0000	1.5335	122.6788	(281)
Energy for lighting	373.5739	1.5547	580.8120	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.2260	1.5113	-775.6337	
PV Unit electricity exported	-216.4379	0.4448	-96.2646	
Total			-871.8983	(283)
Total Primary energy kWh/year			7146.0001	(286)

Full SAP Calculation Printout

Property Reference	P3 Oakley	**Issued on Date**	16/01/2024
Assessment Reference	P3 Oakley	**Prop Type Ref**	Detached
Property	3, Windsor		

SAP Rating	83 B	**DER**	3.06	**TER**	8.31
Environmental	97 A	**% DER < TER**			63.18
CO_2 Emissions (t/year)	0.74	**DFEE**	40.72	**TFEE**	43.12
Compliance Check	See BREL	**% DFEE < TFEE**			5.57
% DPER < TPER	27.71	**DPER**	31.94	**TPER**	44.18

Assessor Details	Mrs. Naomi Sadler	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne Homes		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	6 * 10 =	60.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3073	(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) =	0.2843	(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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(25)

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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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		127.7070			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		105.0411 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838	
E3 Sill	26.7000	0.0450	1.2015	
E4 Jamb	64.4000	0.0510	3.2844	
E5 Ground floor (normal)	54.9200	0.0640	3.5149	
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000	
E16 Corner (normal)	38.5700	0.0570	2.1985	
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430	
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100	
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568	
R6 Flat ceiling	3.4200	0.1200	0.4104	
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607	
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360	
R7 Flat ceiling (inverted)	1.3000	0.1200	0.1560	
R9 Roof to wall (flat ceiling)	1.3000	0.3200	0.4160	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.6720 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.3790 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.5263	285.8988	285.2839	282.3953	281.8548	279.3390	279.3390	278.8731	280.3080	281.8548	282.9481	284.0912	(39)

Average = Sum(39)m / 12 = 282.3927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0590	1.0567	1.0544	1.0437	1.0417	1.0324	1.0324	1.0307	1.0360	1.0417	1.0458	1.0500	(40)
HLP (average)												1.0437	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)

Hot water usage for mixer showers

104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)

Energy content (annual) Total = Sum(45)m = 2807.3415

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

43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:

Store volume 400.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.2000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1880 (55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)

Total per year (kWh/year) = Sum(64)m = 3514.8575 (64)

12Total per year (kWh/year) 3515 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	228.3472	252.8130	228.3472	235.9588	228.3472	235.9588	228.3472	228.3472	235.9588	228.3472	235.9588	228.3472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains	926.4079	952.1476	909.9459	879.1707	832.3976	802.2673	769.8314	769.8675	794.1674	820.7892	872.5236	905.4240	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)

East			12.9200		19.6403		0.7200		0.7000		0.7700	88.6285	(76)
West			21.6000		19.6403		0.7200		0.7000		0.7700	148.1716	(80)
Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1195.8165	1477.6952	1778.7125	2161.8674	2425.0655	2443.3811	2327.7222	2093.0471	1808.7387	1444.6316	1208.0122	1127.3409	(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	27.5522	27.6127	27.6722	27.9552	28.0088	28.2611	28.2611	28.3083	28.1634	28.0088	27.9006	27.7884	
alpha	2.8368	2.8408	2.8448	2.8637	2.8673	2.8841	2.8841	2.8872	2.8776	2.8673	2.8600	2.8526	
util living area	0.9852	0.9727	0.9462	0.8806	0.7695	0.6182	0.4849	0.5451	0.7664	0.9287	0.9761	0.9875	(86)
Living	18.8506	19.0990	19.5014	20.0319	20.4631	20.7353	20.8363	20.8126	20.5808	19.9879	19.3270	18.8149	
Non living	17.4752	17.7926	18.3034	18.9696	19.4859	19.7916	19.8860	19.8702	19.6371	18.9289	18.0916	17.4346	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9004	19.0990	19.5014	20.0319	20.4631	20.7353	20.8363	20.8126	20.5808	19.9879	19.3270	19.1205	(87)
Th 2	20.0344	20.0364	20.0382	20.0470	20.0487	20.0564	20.0564	20.0578	20.0534	20.0487	20.0454	20.0419	(88)
util rest of house	0.9829	0.9684	0.9374	0.8606	0.7302	0.5522	0.3950	0.4540	0.7115	0.9126	0.9715	0.9855	(89)
MIT 2	19.0142	17.7926	18.3034	18.9696	19.4859	19.7916	19.8860	19.8702	19.6371	18.9289	18.0916	17.9044	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.1973	18.0626	18.5509	19.1891	19.6878	19.9866	20.0824	20.0649	19.8321	19.1477	18.3469	18.1557	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1973	18.0626	18.5509	19.1891	19.6878	19.9866	20.0824	20.0649	19.8321	19.1477	18.3469	18.1557	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9804	0.9561	0.9196	0.8388	0.7133	0.5469	0.3976	0.4547	0.6967	0.8928	0.9602	0.9800	(94)
Useful gains	1172.3436	1412.8520	1635.6701	1813.3808	1729.7346	1336.2577	925.4483	951.6909	1260.1415	1289.7412	1159.9214	1104.8372	(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	4268.4705	3763.1656	3437.9337	2905.6041	2251.4002	1504.6911	972.7722	1022.0462	1606.7555	2409.2165	3182.2939	3964.6971	(97)
Space heating kWh	2303.5184	1579.4108	1340.8841	786.4008	388.1192	0.0000	0.0000	0.0000	0.0000	832.8896	1456.1082	2127.7358	(98a)
Space heating requirement - total per year (kWh/year)												10815.0669	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2303.5184	1579.4108	1340.8841	786.4008	388.1192	0.0000	0.0000	0.0000	0.0000	832.8896	1456.1082	2127.7358	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10815.0669	
Space heating per m2											(98c) / (4) =	39.9729	(99)

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 %)												299.9045	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement	2303.5184	1579.4108	1340.8841	786.4008	388.1192	0.0000	0.0000	0.0000	0.0000	832.8896	1456.1082	2127.7358	(98)
Space heating efficiency (main heating system 1)	299.9045	299.9045	299.9045	299.9045	299.9045	0.0000	0.0000	0.0000	0.0000	299.9045	299.9045	299.9045	(210)
Space heating fuel (main heating system)	768.0839	526.6378	447.1037	262.2170	129.4143	0.0000	0.0000	0.0000	0.0000	277.7183	485.5239	709.4710	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8277	(216)
(217)m	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	(217)
Fuel for water heating, kWh/month	209.2351	185.0977	196.4126	171.7183	165.8881	148.8208	146.2128	152.2649	154.2438	172.8180	184.8260	206.7868	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	46.4763	37.2850	33.5710	24.5956	18.9983	15.5218	17.3309	22.5274	29.2608	38.3918	43.3634	47.7680	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.7443	-28.0119	-45.0203	-56.0830	-64.6828	-60.2454	-59.4063	-53.5154	-44.0615	-33.9386	-20.4050	-14.9603	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.2903	-5.4201	-11.9182	-20.2258	-29.5903	-32.4401	-32.0543	-26.3942	-18.5238	-8.7998	-3.3589	-1.8052	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3606.1699	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.8277	
Water heating fuel used	2094.3251	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	375.0901	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5384.6893	(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 (high-rate cost)	2884.9359	0.1627	469.3912	(261)
Space heating - main system 1 (low-rate cost)	721.2340	0.1366	98.5134	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.0275	0.1479	216.8910	(264)
Water heating - low rate cost	628.2975	0.1242	78.0136	(264)
Space and water heating			862.8092	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	375.0901	0.1490	55.8958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-498.0747	0.1371	-68.2822	
PV Unit electricity exported	-192.8211	0.1218	-23.4937	
Total			-91.7759	(269)
Total CO2, kg/year			826.9291	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2884.9359	1.2853	4634.9601	(275)
Space heating - main system 1 (low-rate cost)	721.2340	1.4942	1077.6798	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1466.0275	1.5530	2276.7649	(278)
Water heating - low rate cost	628.2975	1.4444	907.4856	(278)
Space and water heating			8896.8905	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	375.0901	1.5547	583.1693	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-498.0747	1.5112	-752.6818	
PV Unit electricity exported	-192.8211	0.4470	-86.1856	
Total			-838.8674	(283)
Total Primary energy kWh/year			8641.1924	(286)
Dwelling Primary energy Rate (DPER)			31.9400	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b)	= 342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c)	= 403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 745.3928	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	

Measured/design AP50												5.0000	(17)
Infiltration rate												0.3037	(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) =				0.2809	(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	0.3581	0.3511	0.3441	0.3090	0.3020	0.2668	0.2668	0.2598	0.2809	0.3020	0.3160	0.3300	(22b)
Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545	(25)

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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 Semi-glazed door			4.4800	1.0000	4.4800			(26a)
TER Opening Type (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1300	17.6150			(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771			(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1800	10.4922			(29a)
External Roof 1	5.1300		5.1300	0.1100	0.5643			(30)
External Roof 3	131.0000		131.0000	0.1100	14.4100			(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	132.5187			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	105.0411	(35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	28.8300	0.0500	1.4415
E3	Sill	26.7000	0.0500	1.3350
E4	Jamb	64.4000	0.0500	3.2200
E5	Ground floor (normal)	54.9200	0.1600	8.7872
E6	Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16	Corner (normal)	38.5700	0.0900	3.4713
E17	Corner (inverted - internal area greater than external area)	16.5300	-0.0900	-1.4877
E13	Gable (insulation at rafter level)	1.0000	0.0800	0.0800
E11	Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6	Flat ceiling	3.4200	0.0600	0.2052
E12	Gable (insulation at ceiling level)	24.1198	0.0600	1.4472
E10	Eaves (insulation at ceiling level)	24.3500	0.0600	1.4610
R7	Flat ceiling (inverted)	1.3000	0.0400	0.0520
R9	Roof to wall (flat ceiling)	1.3000	0.0400	0.0520

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3215	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	152.8402	(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	138.7644	138.1518	137.5514	134.7313	134.2036	131.7474	131.7474	131.2925	132.6935	134.2036	135.2710	136.3870	(38)
Heat transfer coeff	291.6045	290.9920	290.3916	287.5715	287.0438	284.5876	284.5876	284.1327	285.5337	287.0438	288.1112	289.2271	(39)
Average = Sum(39)m / 12 =												287.5689	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0778	1.0755	1.0733	1.0629	1.0609	1.0518	1.0518	1.0502	1.0553	1.0609	1.0649	1.0690	(40)
HLP (average)												1.0629	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0937	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
76.0904	74.9469	73.2806	70.0924	67.7397	65.1159	63.6245	65.2782	67.0909	69.9081	73.1647	75.7988	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day)	142.7068	(43)

Daily hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
155.2471	151.9317	147.8944	141.7557	136.7705	131.4110	129.3516	133.3715	137.6110	143.2375	149.4708	154.8445	(44)
245.8734	216.3488	227.3083	194.0565	184.1194	161.5852	156.4396	165.1418	169.6881	194.3719	212.9485	242.4491	(45)

Energy content (annual) Total = Sum(45)m =	2370.3305	

Distribution loss (46)m = 0.15 x (45)m		
36.8810 32.4523 34.0962 29.1085 27.6179 24.2378 23.4659 24.7713 25.4532 29.1558 31.9423 36.3674		(46)
Water storage loss:		
Store volume	400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.5234	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.3626	(55)

Total storage loss

42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(56)

If cylinder contains dedicated solar storage

42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(57)
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)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

311.3775	275.5138	292.8124	257.4475	249.6235	224.9763	221.9437	230.6459	233.0792	259.8760	276.3396	307.9532	(62)
-34.7853	-30.7644	-32.2147	-26.6751	-24.8602	-21.2731	-19.9401	-21.2043	-22.0099	-25.9473	-29.3951	-34.1412	(63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
276.5922	244.7493	260.5976	230.7725	224.7632	203.7032	202.0036	209.4416	211.0693	233.9287	246.9445	273.8120	(64)

Total per year (kWh/year) = Sum(64)m =	2818.3778	(64)
12Total per year (kWh/year)	2818	(64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)

Heat gains from water heating, kWh/month

	134.1562	119.2680	127.9833	115.2366	113.6230	104.4399	104.4195	107.3129	107.1342	117.0320	121.5183	133.0176 (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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)

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

	228.3472	252.8130	228.3472	235.9588	228.3472	235.9588	228.3472	228.3472	235.9588	228.3472	235.9588	228.3472	(67)

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

	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)

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

	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)

Water heating gains (Table 5)

	180.3175	177.4821	172.0206	160.0509	152.7191	145.0555	140.3487	144.2378	148.7975	157.3010	168.7754	178.7871	(72)

Total internal gains

	915.0330	941.1666	899.8914	871.3750	825.9361	794.2227	762.7567	762.1426	785.6617	813.7120	863.2934	894.3551	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.6300	0.7000	0.7700	28.5324	(74)
East	12.9200	19.6403	0.6300	0.7000	0.7700	77.5500	(76)
West	21.6000	19.6403	0.6300	0.7000	0.7700	129.6501	(80)

Solar gains	235.7325	459.8542	760.1708	1122.3596	1393.5844	1435.9746	1363.1545	1157.7822	887.7498	545.8621	293.5525	194.1773	(83)
Total gains	1150.7655	1401.0208	1660.0622	1993.7347	2219.5205	2230.1972	2125.9112	1919.9248	1673.4116	1359.5741	1156.8459	1088.5323	(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	27.0724	27.1294	27.1854	27.4520	27.5025	27.7399	27.7399	27.7843	27.6480	27.5025	27.4006	27.2949	
alpha	2.8048	2.8086	2.8124	2.8301	2.8335	2.8493	2.8493	2.8523	2.8432	2.8335	2.8267	2.8197	
util living area	0.9866	0.9761	0.9545	0.8998	0.8030	0.6614	0.5274	0.5868	0.7968	0.9383	0.9786	0.9885	(86)
MIT	18.2002	18.5109	19.0280	19.7297	20.3310	20.7380	20.9009	20.8635	20.5189	19.7108	18.8366	18.1552	(87)
Th 2	20.0190	20.0209	20.0227	20.0313	20.0329	20.0404	20.0404	20.0417	20.0375	20.0329	20.0296	20.0262	(88)
util rest of house	0.9844	0.9723	0.9467	0.8820	0.7661	0.5948	0.4318	0.4920	0.7446	0.9239	0.9744	0.9867	(89)
MIT 2	16.6991	17.0960	17.7534	18.6363	19.3637	19.8251	19.9811	19.9542	19.6018	18.6282	17.5192	16.6456	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.0093	17.3884	18.0168	18.8622	19.5636	20.0137	20.1711	20.1421	19.7913	18.8520	17.7914	16.9576	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0093	17.3884	18.0168	18.8622	19.5636	20.0137	20.1711	20.1421	19.7913	18.8520	17.7914	16.9576	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9738	0.9566	0.9245	0.8548	0.7453	0.5928	0.4457	0.5028	0.7289	0.8997	0.9599	0.9772	(94)
Useful gains	1120.5682	1340.2065	1534.7778	1704.1968	1654.2780	1321.9650	947.5189	965.2623	1219.6838	1223.2046	1110.4080	1063.7434	(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	3706.0832	3634.0221	3344.3739	2864.8568	2257.2032	1540.6778	1016.3049	1063.2478	1625.0661	2368.6742	3080.3129	3689.8339	(97)
Space heating kWh	1923.6232	1541.4440	1346.3395	835.6752	448.5764	0.0000	0.0000	0.0000	0.0000	852.2293	1418.3315	1953.8113	(98a)
Space heating requirement - total per year (kWh/year)												10320.0304	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1923.6232	1541.4440	1346.3395	835.6752	448.5764	0.0000	0.0000	0.0000	0.0000	852.2293	1418.3315	1953.8113	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10320.0304	
Space heating per m2											(98c) / (4) =	38.1432	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1923.6232	1541.4440	1346.3395	835.6752	448.5764	0.0000	0.0000	0.0000	0.0000	852.2293	1418.3315	1953.8113	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	2084.0988	1670.0369	1458.6560	905.3902	485.9982	0.0000	0.0000	0.0000	0.0000	923.3254	1536.6538	2116.8053	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													

	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													
	276.5922	244.7493	260.5976	230.7725	224.7632	203.7032	202.0036	209.4416	211.0693	233.9287	246.9445	273.8120	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5586	87.4486	87.2050	86.6844	85.5782	79.8000	79.8000	79.8000	79.8000	86.6942	87.3393	87.5858	(217)
Fuel for water heating, kWh/month													
	315.8938	279.8779	298.8333	266.2213	262.6407	255.2672	253.1374	262.4581	264.4978	269.8321	282.7416	312.6214	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	47.4460	38.0630	34.2715	25.1088	19.3947	15.8457	17.6925	22.9974	29.8714	39.1928	44.2682	48.7647	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-108.0209	-143.7171	-194.9441	-206.2309	-211.7449	-193.5879	-190.7824	-184.8988	-173.5770	-157.4838	-115.4756	-94.3901	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-90.0556	-185.1547	-360.5684	-531.3197	-693.1896	-693.4880	-685.6816	-585.0853	-434.7210	-261.7051	-119.1481	-71.5823	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	11180.9647	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3324.0226	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	382.9167	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6686.5529	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	8287.3511	(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	11180.9647	0.2100	2348.0026	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3324.0226	0.2100	698.0448	(264)
Space and water heating			3046.0473	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	382.9167	0.1443	55.2667	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1974.8535	0.1359	-268.4026	
PV Unit electricity exported	-4711.6994	0.1265	-595.8209	
Total			-864.2234	(269)
Total CO2, kg/year			2249.0199	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.3100	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	11180.9647	1.1300	12634.4901	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3324.0226	1.1300	3756.1456	(278)
Space and water heating			16390.6357	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	382.9167	1.5338	587.3305	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1974.8535	1.5024	-2966.9679	
PV Unit electricity exported	-4711.6994	0.4642	-2187.1846	
Total			-5154.1525	(283)
Total Primary energy kWh/year			11953.9144	(286)
Target Primary Energy Rate (TPER)			44.1800	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)

Ground floor	135.2800 (1b) x	2.5300 (2b) =	342.2584 (1b) - (3b)
First floor	135.2800 (1c) x	2.9800 (2c) =	403.1344 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	745.3928 (5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2537	(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) =	0.2346	(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	0.2992	0.2933	0.2874	0.2581	0.2522	0.2229	0.2229	0.2170	0.2346	0.2522	0.2640	0.2757	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5447	0.5430	0.5413	0.5333	0.5318	0.5248	0.5248	0.5236	0.5275	0.5318	0.5348	0.5380	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		127.7070			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		105.0411 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838
E3 Sill	26.7000	0.0450	1.2015
E4 Jamb	64.4000	0.0510	3.2844
E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360
R7 Flat ceiling (inverted)	1.3000	0.1200	0.1560
R9 Roof to wall (flat ceiling)	1.3000	0.3200	0.4160

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.6720 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	147.3790 (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	133.9973	133.5698	133.1509	131.1830	130.8148	129.1008	129.1008	128.7834	129.7610	130.8148	131.5596	132.3383	(38)
Heat transfer coeff	281.3763	280.9489	280.5299	278.5620	278.1938	276.4799	276.4799	276.1625	277.1401	278.1938	278.9387	279.7174	(39)

Average = Sum(39)m / 12 =	278.5603

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0400	1.0384	1.0368	1.0296	1.0282	1.0219	1.0219	1.0207	1.0243	1.0282	1.0310	1.0338	(40)
HLP (average)												1.0296	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0937 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

	46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122 (42c)

Average daily hot water use (litres/day) 72.5540 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	79.1567	76.9849	74.6139	71.6633	69.0308	66.2951	65.7271	68.0933	70.5201	73.3294	76.3061	79.0457	(44)
Energy conte	125.3649	109.6254	114.6787	98.1034	92.9287	81.5176	79.4913	84.3137	86.9583	99.5073	108.7120	123.7664	(45)
Energy content (annual)											Total = Sum(45)m =	1204.9678	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(64)
											Total per year (kWh/year) = Sum(64)m =	1024.2226	(64)
12Total per year (kWh/year)												1024	(64)
Electric shower(s)													
	60.9357	54.2942	59.2872	56.5770	57.6387	54.9817	56.8144	57.6387	56.5770	59.2872	58.1724	60.9357	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												693.1400	(64a)
Heat gains from water heating, kWh/month													
	41.8740	36.8690	39.1910	34.9912	34.1570	31.0679	31.0955	32.3263	32.6229	35.9671	37.6444	41.5343	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	228.3472	252.8130	228.3472	235.9588	228.3472	235.9588	228.3472	228.3472	235.9588	228.3472	235.9588	228.3472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	56.2822	54.8645	52.6761	48.5989	45.9100	43.1499	41.7950	43.4494	45.3096	48.3429	52.2839	55.8257	(72)
Total internal gains													
	787.9978	815.5490	777.5470	756.9231	716.1271	692.3171	664.2030	661.3542	682.1739	701.7538	743.8019	768.3936	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)
East	12.9200	19.6403	0.7200	0.7000	0.7700	88.6285	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1057.4063	1341.0967	1646.3136	2039.6198	2308.7949	2333.4309	2222.0939	1984.5338	1696.7451	1325.5963	1079.2905	990.3105	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.0565	28.0992	28.1411	28.3399	28.3774	28.5533	28.5533	28.5862	28.4853	28.3774	28.3017	28.2229	
alpha	2.8704	2.8733	2.8761	2.8893	2.8918	2.9036	2.9036	2.9057	2.8990	2.8918	2.8868	2.8815	
util living area													
	0.9893	0.9784	0.9545	0.8922	0.7837	0.6340	0.4998	0.5637	0.7862	0.9404	0.9819	0.9911	(86)
MIT	18.2251	18.5594	19.1017	19.8177	20.4067	20.7783	20.9191	20.8841	20.5582	19.7441	18.8530	18.1698	(87)
Th 2	20.0502	20.0515	20.0527	20.0588	20.0599	20.0651	20.0651	20.0661	20.0631	20.0599	20.0576	20.0552	(88)
util rest of house													
	0.9875	0.9749	0.9469	0.8737	0.7458	0.5684	0.4090	0.4721	0.7336	0.9266	0.9784	0.9896	(89)
MIT 2	17.4769	17.8098	18.3469	19.0475	19.5993	19.9240	20.0275	20.0083	19.7516	18.9894	18.1080	17.4251	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6315	17.9647	18.5029	19.2067	19.7661	20.1005	20.2118	20.1893	19.9183	19.1454	18.2620	17.5790	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6315	17.9647	18.5029	19.2067	19.7661	20.1005	20.2118	20.1893	19.9183	19.1454	18.2620	17.5790	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9641	0.9304	0.8534	0.7324	0.5711	0.4240	0.4850	0.7243	0.9089	0.9688	0.9840	(94)
Useful gains	1037.2154	1292.9603	1531.6971	1740.5813	1690.9013	1332.6000	942.1953	962.5248	1228.9480	1204.8564	1045.6258	974.4225	(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													
	3751.1720	3670.5214	3367.1740	2871.0458	2243.9475	1520.7839	998.5798	1046.4500	1612.4889	2377.2725	3113.5072	3742.3456	(97)
Space heating kWh													
	2019.1837	1597.7210	1365.5948	813.9345	411.4664	0.0000	0.0000	0.0000	0.0000	872.2775	1488.8746	2059.3348	(98a)
Space heating requirement - total per year (kWh/year)												10628.3873	

Solar heating kWh

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

2019.1837	1597.7210	1365.5948	813.9345	411.4664	0.0000	0.0000	0.0000	0.0000	872.2775	1488.8746	2059.3348	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 10628.3873

Space heating per m2 (98c) / (4) = 39.2829 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2598.9109	2045.9511	2098.8348	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7458	0.8114	0.7636	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1938.3410	1660.0543	1602.5875	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2612.9827	2487.3848	2214.4532	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	485.7420	615.5338	455.2281	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	121.4355	153.8835	113.8070	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												389.1260	(107)
Energy for space heating												39.2829	(99)
Energy for space cooling												1.4382	(108)
Total												40.7211	(109)
Fabric Energy Efficiency (DFEE)												40.7	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0537 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3037 (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) =	0.2809 (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													
	0.3581	0.3511	0.3441	0.3090	0.3020	0.2668	0.2668	0.2598	0.2809	0.3020	0.3160	0.3300	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545	(25)

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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 Semi-glazed door			4.4800	1.0000	4.4800			(26a)
TER Opening Type (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1300	17.6150			(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771			(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1800	10.4922			(29a)
External Roof 1	5.1300		5.1300	0.1100	0.5643			(30)
External Roof 3	131.0000		131.0000	0.1100	14.4100			(30)

Total net area of external elements Aum(A, m2) 574.2392 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 132.5187 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 105.0411 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.8300	0.0500	1.4415
E3 Sill	26.7000	0.0500	1.3350
E4 Jamb	64.4000	0.0500	3.2200
E5 Ground floor (normal)	54.9200	0.1600	8.7872
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0900	3.4713
E17 Corner (inverted - internal area greater than external area)	16.5300	-0.0900	-1.4877
E13 Gable (insulation at rafter level)	1.0000	0.0800	0.0800
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.0600	0.2052
E12 Gable (insulation at ceiling level)	24.1198	0.0600	1.4472
E10 Eaves (insulation at ceiling level)	24.3500	0.0600	1.4610
R7 Flat ceiling (inverted)	1.3000	0.0400	0.0520
R9 Roof to wall (flat ceiling)	1.3000	0.0400	0.0520

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 20.3215 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 152.8402 (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	138.7644	138.1518	137.5514	134.7313	134.2036	131.7474	131.7474	131.2925	132.6935	134.2036	135.2710	136.3870	(38)
Heat transfer coeff	291.6045	290.9920	290.3916	287.5715	287.0438	284.5876	284.5876	284.1327	285.5337	287.0438	288.1112	289.2271	(39)
Average = Sum(39)m / 12 =												287.5689	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0778	1.0755	1.0733	1.0629	1.0609	1.0518	1.0518	1.0502	1.0553	1.0609	1.0649	1.0690	(40)
HLP (average)												1.0629	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 72.5540 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	79.1567	76.9849	74.6139	71.6633	69.0308	66.2951	65.7271	68.0933	70.5201	73.3294	76.3061	79.0457	(44)
Energy conte	125.3649	109.6254	114.6787	98.1034	92.9287	81.5176	79.4913	84.3137	86.9583	99.5073	108.7120	123.7664	(45)
Energy content (annual)											Total = Sum(45)m =	1204.9678	

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

106.5602	93.1816	97.4769	83.3879	78.9894	69.2900	67.5676	71.6667	73.9146	84.5812	92.4052	105.2015	(64)
										Total per year (kWh/year) = Sum(64)m =	1024.2226	(64)
12Total per year (kWh/year)											1024	(64)

Electric shower(s)

60.9357	54.2942	59.2872	56.5770	57.6387	54.9817	56.8144	57.6387	56.5770	59.2872	58.1724	60.9357	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 693.1400 (64a)

Heat gains from water heating, kWh/month

41.8740	36.8690	39.1910	34.9912	34.1570	31.0679	31.0955	32.3263	32.6229	35.9671	37.6444	41.5343	(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	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	154.6829	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	228.3472	252.8130	228.3472	235.9588	228.3472	235.9588	228.3472	228.3472	235.9588	228.3472	235.9588	228.3472	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	433.9635	438.4667	427.1188	402.9605	372.4650	343.8035	324.6559	320.1527	331.5006	355.6589	386.1544	414.8158	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	38.4683	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	56.2822	54.8645	52.6761	48.5989	45.9100	43.1499	41.7950	43.4494	45.3096	48.3429	52.2839	55.8257	(72)
Total internal gains	787.9978	815.5490	777.5470	756.9231	716.1271	692.3171	664.2030	661.3542	682.1739	701.7538	743.8019	768.3936	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North			8.7800	10.6334	0.6300	0.7000	0.7700	28.5324	(74)				
East			12.9200	19.6403	0.6300	0.7000	0.7700	77.5500	(76)				
West			21.6000	19.6403	0.6300	0.7000	0.7700	129.6501	(80)				
Solar gains	235.7325	459.8542	760.1708	1122.3596	1393.5844	1435.9746	1363.1545	1157.7822	887.7498	545.8621	293.5525	194.1773	(83)
Total gains	1023.7302	1275.4032	1537.7178	1879.2827	2109.7114	2128.2917	2027.3575	1819.1364	1569.9237	1247.6160	1037.3544	962.5709	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.0724	27.1294	27.1854	27.4520	27.5025	27.7399	27.7399	27.7843	27.6480	27.5025	27.4006	27.2949	
alpha	2.8048	2.8086	2.8124	2.8301	2.8335	2.8493	2.8493	2.8523	2.8432	2.8335	2.8267	2.8197	
util living area	0.9900	0.9810	0.9618	0.9112	0.8189	0.6802	0.5467	0.6091	0.8170	0.9491	0.9836	0.9916	(86)
MIT	18.1088	18.4236	18.9488	19.6682	20.2897	20.7172	20.8912	20.8494	20.4806	19.6417	18.7525	18.0638	(87)
Th 2	20.0190	20.0209	20.0227	20.0313	20.0329	20.0404	20.0404	20.0417	20.0375	20.0329	20.0296	20.0262	(88)
util rest of house	0.9884	0.9779	0.9552	0.8949	0.7836	0.6141	0.4495	0.5134	0.7675	0.9367	0.9804	0.9902	(89)
MIT 2	17.3411	17.6552	18.1770	18.8863	19.4758	19.8578	19.9891	19.9655	19.6669	18.8723	17.9902	17.3008	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.4997	17.8140	18.3365	19.0479	19.6440	20.0354	20.1755	20.1482	19.8351	19.0313	18.1477	17.4585	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4997	17.8140	18.3365	19.0479	19.6440	20.0354	20.1755	20.1482	19.8351	19.0313	18.1477	17.4585	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9820	0.9677	0.9396	0.8742	0.7672	0.6137	0.4642	0.5250	0.7552	0.9195	0.9713	0.9847	(94)
Useful gains	1005.3028	1234.2256	1444.9100	1642.9259	1618.4675	1306.1320	941.0680	955.1358	1185.5953	1147.2320	1007.5488	947.8653	(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	3849.0960	3757.8764	3437.2088	2918.2369	2280.2684	1546.8455	1017.5490	1064.9753	1637.5557	2420.1582	3182.9710	3834.7134	(97)
Space heating kWh	2115.7821	1695.8934	1482.2703	918.2239	492.3799	0.0000	0.0000	0.0000	0.0000	947.0570	1566.3040	2147.8149	(98a)
Space heating requirement - total per year (kWh/year)												11365.7255	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2115.7821	1695.8934	1482.2703	918.2239	492.3799	0.0000	0.0000	0.0000	0.0000	947.0570	1566.3040	2147.8149	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11365.7255	
Space heating per m2											(98c) / (4) =	42.0082	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2675.1232	2105.9481	2159.4086	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6944	0.7657	0.7154	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1857.6496	1612.5441	1544.9285	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2373.2096	2259.7708	2021.1315	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	371.2032	481.5367	354.2951	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	92.8008	120.3842	88.5738	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												301.7587	(107)
Energy for space heating												42.0082	(99)
Energy for space cooling												1.1153	(108)
Total												43.1235	(109)
Fabric Energy Efficiency (TFEE)												43.1	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b) =	342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c) =	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		745.3928	(5)

2. Ventilation rate

m3 per hour

Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	6 * 10 =	60.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3073	(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) =	0.2843	(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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(25)

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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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	127.7070			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		105.0411 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838
E3 Sill	26.7000	0.0450	1.2015
E4 Jamb	64.4000	0.0510	3.2844
E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360
R7 Flat ceiling (inverted)	1.3000	0.1200	0.1560
R9 Roof to wall (flat ceiling)	1.3000	0.3200	0.4160

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.6720 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	147.3790 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.5263	285.8988	285.2839	282.3953	281.8548	279.3390	279.3390	278.8731	280.3080	281.8548	282.9481	284.0912	(39)
Average = Sum(39)m / 12 =												282.3927	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0590	1.0567	1.0544	1.0437	1.0417	1.0324	1.0324	1.0307	1.0360	1.0417	1.0458	1.0500	(40)
HLP (average)												1.0437	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0937 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day)	169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	

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

43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)

Water storage loss:	
Store volume	400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.2000 (48)

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
									Total per year (kWh/year) = Sum(64)m =			3514.8575	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month													
	144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	53.0979	47.1611	38.3540	29.0364	21.7051	18.3243	19.8001	25.7369	34.5440	43.8616	51.1929	54.5736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains	1014.0257	1011.5807	979.4484	919.8453	858.3323	803.0928	770.3133	774.0682	805.1530	860.6027	927.0770	985.0866	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)
East	12.9200	19.6403	0.7200	0.7000	0.7700	88.6285	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1283.4343	1537.1284	1848.2151	2202.5420	2451.0001	2444.2066	2328.2041	2097.2478	1819.7242	1484.4451	1262.5656	1207.0035	(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	27.5522	27.6127	27.6722	27.9552	28.0088	28.2611	28.2611	28.3083	28.1634	28.0088	27.9006	27.7884	
alpha	2.8368	2.8408	2.8448	2.8637	2.8673	2.8841	2.8841	2.8872	2.8776	2.8673	2.8600	2.8526	
util living area													
	0.9824	0.9700	0.9414	0.8763	0.7658	0.6181	0.4848	0.5442	0.7643	0.9244	0.9733	0.9851	(86)
Living	18.8974	19.1294	19.5336	20.0468	20.4692	20.7354	20.8363	20.8129	20.5834	20.0053	19.3553	18.8579	
Non living	17.5347	17.8310	18.3434	18.9873	19.4925	19.7917	19.8861	19.8704	19.6397	18.9499	18.1274	17.4894	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9244	19.1294	19.5336	20.0468	20.4692	20.7354	20.8363	20.8129	20.5834	20.0053	19.3553	19.1575	(87)
Th 2	20.0344	20.0364	20.0382	20.0470	20.0487	20.0564	20.0564	20.0578	20.0534	20.0487	20.0454	20.0419	(88)
util rest of house													
	0.9796	0.9653	0.9319	0.8557	0.7261	0.5520	0.3949	0.4532	0.7092	0.9075	0.9683	0.9828	(89)
MIT 2	19.0379	17.8310	18.3434	18.9873	19.4925	19.7917	19.8861	19.8704	19.6397	18.9499	18.1274	17.9493	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.2211	18.0993	18.5894	19.2063	19.6943	19.9867	20.0824	20.0652	19.8347	19.1680	18.3811	18.1990	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2211	18.0993	18.5894	19.2063	19.6943	19.9867	20.0824	20.0652	19.8347	19.1680	18.3811	18.1990	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9767	0.9523	0.9135	0.8339	0.7095	0.5468	0.3975	0.4540	0.6945	0.8874	0.9562	0.9765	(94)
Useful gains	1253.5687	1463.7683	1688.2579	1836.7432	1738.9114	1336.3865	925.4751	952.0524	1263.7668	1317.2763	1207.2488	1178.6986	(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													
	4275.2770	3773.6622	3448.8988	2910.4441	2253.2383	1504.7155	972.7772	1022.1145	1607.4800	2414.9393	3191.9681	3976.9940	(97)
Space heating kWh													
	2248.1509	1552.2487	1309.9168	773.0647	382.6592	0.0000	0.0000	0.0000	0.0000	816.6612	1428.9979	2081.9317	(98a)
Space heating requirement - total per year (kWh/year)												10593.6313	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2248.1509	1552.2487	1309.9168	773.0647	382.6592	0.0000	0.0000	0.0000	0.0000	816.6612	1428.9979	2081.9317	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10593.6313	

Space heating per m2 (98c) / (4) = 39.1545 (99)

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 %) 299.9045 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2248.1509	1552.2487	1309.9168	773.0647	382.6592	0.0000	0.0000	0.0000	0.0000	816.6612	1428.9979	2081.9317	(98)
Space heating efficiency (main heating system 1)													
	299.9045	299.9045	299.9045	299.9045	299.9045	0.0000	0.0000	0.0000	0.0000	299.9045	299.9045	299.9045	(210)
Space heating fuel (main heating system)													
	749.6222	517.5810	436.7779	257.7703	127.5937	0.0000	0.0000	0.0000	0.0000	272.3071	476.4843	694.1982	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8277	(216)
(217)m	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	(217)
Fuel for water heating, kWh/month													
	209.2351	185.0977	196.4126	171.7183	165.8881	148.8208	146.2128	152.2649	154.2438	172.8180	184.8260	206.7868	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	46.4763	37.2850	33.5710	24.5956	18.9983	15.5218	17.3309	22.5274	29.2608	38.3918	43.3634	47.7680	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.7318	-27.9942	-44.9764	-56.0439	-64.6558	-60.2454	-59.4063	-53.5154	-44.0615	-33.9168	-20.3934	-14.9517	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.3028	-5.4378	-11.9621	-20.2649	-29.6173	-32.4401	-32.0543	-26.3942	-18.5238	-8.8216	-3.3705	-1.8139	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 3532.3345 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 167.8277
Water heating fuel used 2094.3251 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 0.0000 (231)
Electricity for lighting (calculated in Appendix L) 375.0901 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 5310.8539 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2825.8676	17.5600	553.8701	(240)
Space heating - main system 1 (low-rate cost)	706.4669	0.0940	66.4079	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1466.0275	19.6000	287.3414	(245)
Low-rate cost	628.2975	9.4000	59.0600	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	375.0901	18.5800	69.6917	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.8924	18.5800	-92.5084	
PV Unit electricity exported	-193.0034	5.5900	-10.7889	
Total			-103.2973	(252)
Total energy cost			940.0738	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.0725 (257)
SAP value 82.6154
SAP rating (Section 12) 83 (258)

SAP band B

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 (high-rate cost)	2825.8676	0.1627	459.7328	(261)
Space heating - main system 1 (low-rate cost)	706.4669	0.1366	96.4867	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.0275	0.1479	216.8910	(264)
Water heating - low rate cost	628.2975	0.1242	78.0136	(264)
Space and water heating			851.1242	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	375.0901	0.1490	55.8958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-497.8924	0.1371	-68.2545	
PV Unit electricity exported	-193.0034	0.1219	-23.5233	
Total			-91.7778	(269)
Total CO2, kg/year			815.2422	(272)
CO2 emissions per m2			3.0100	(273)
EI value			96.5381	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b) =	342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c) =	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		745.3928	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3073 (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) =	0.2843 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2985	0.2843	0.2843	0.2630	0.2630	0.2345	0.2416	0.2274	0.2345	0.2487	0.2487	0.2701	(22b)
Effective ac	0.5445	0.5404	0.5404	0.5346	0.5346	0.5275	0.5292	0.5259	0.5275	0.5309	0.5309	0.5365	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		127.7070			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				105.0411 (35)
List of Thermal Bridges				
K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838	
E3 Sill	26.7000	0.0450	1.2015	
E4 Jamb	64.4000	0.0510	3.2844	
E5 Ground floor (normal)	54.9200	0.0640	3.5149	
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000	
E16 Corner (normal)	38.5700	0.0570	2.1985	
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430	
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100	
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568	
R6 Flat ceiling	3.4200	0.1200	0.4104	
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607	
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360	
R7 Flat ceiling (inverted)	1.3000	0.1200	0.1560	
R9 Roof to wall (flat ceiling)	1.3000	0.3200	0.4160	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				19.6720 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	147.3790 (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	133.9478	132.9290	132.9290	131.4940	131.4940	129.7547	130.1709	129.3509	129.7547	130.5995	130.5995	131.9599	(38)
Heat transfer coeff	281.3268	280.3080	280.3080	278.8731	278.8731	277.1337	277.5499	276.7299	277.1337	277.9786	277.9786	279.3390	(39)
Average = Sum(39)m / 12 =												278.6277	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0398	1.0360	1.0360	1.0307	1.0307	1.0243	1.0258	1.0228	1.0243	1.0274	1.0274	1.0324	(40)
HLP (average)												1.0298	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0937	(42)
Hot water usage for mixer showers													
	104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)
Hot water usage for baths													
	32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)
Hot water usage for other uses													
	46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)
Average daily hot water use (litres/day)												169.0141	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	
Distribution loss (46)m = 0.15 x (45)m													
	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
										Total per year (kWh/year) = Sum(64)m =		3514.8575	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	144.8511	128.6632	137.6958	123.0095	120.6623	110.2321	109.6830	113.0602	113.2583	124.5294	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	53.0979	47.1611	38.3540	29.0364	21.7051	18.3243	19.8001	25.7369	34.5440	43.8616	51.1929	54.5736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	194.6924	191.4631	185.0750	170.8466	162.1806	153.1001	147.4234	151.9626	157.3032	167.3782	181.0055	192.8560	(72)
Total internal gains													
	1014.0257	1011.5807	979.4484	919.8453	858.3323	803.0928	770.3133	774.0682	805.1530	860.6027	927.0770	985.0866	(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				
North				8.7800	11.9814		0.7200		0.7000		0.7700	36.7424	(74)
East				12.9200	22.3313		0.7200		0.7000		0.7700	100.7722	(76)
West				21.6000	22.3313		0.7200		0.7000		0.7700	168.4736	(80)
Solar gains	305.9881	537.5224	877.4305	1332.7214	1609.3764	1773.2814	1665.7305	1448.8464	1110.0536	681.2968	390.4834	249.5257	(83)
Total gains	1320.0139	1549.1032	1856.8789	2252.5667	2467.7087	2576.3742	2436.0438	2222.9146	1915.2065	1541.8995	1317.5604	1234.6122	(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	28.0614	28.1634	28.1634	28.3083	28.3083	28.4860	28.4433	28.5275	28.4860	28.3994	28.3994	28.2611	
alpha	2.8708	2.8776	2.8776	2.8872	2.8872	2.8991	2.8962	2.9018	2.8991	2.8933	2.8933	2.8841	
util living area	0.9786	0.9658	0.9310	0.8467	0.7042	0.4926	0.3418	0.3813	0.6753	0.8978	0.9650	0.9819	(86)
Living	19.0806	19.2842	19.7048	20.2145	20.6118	20.8275	20.8781	20.8725	20.7143	20.1909	19.5536	19.0490	
Non living	17.7792	18.0396	18.5699	19.1999	19.6614	19.8833	19.9202	19.9202	19.7852	19.1873	18.3898	17.7434	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0181	19.2842	19.7048	20.2145	20.6118	20.8275	20.8781	20.8725	20.7143	20.1909	19.5536	19.3219	(87)
Th 2	20.0503	20.0534	20.0534	20.0578	20.0578	20.0631	20.0619	20.0644	20.0631	20.0605	20.0605	20.0564	(88)
util rest of house	0.9751	0.9602	0.9194	0.8208	0.6539	0.4138	0.2431	0.2767	0.6028	0.8742	0.9582	0.9789	(89)
MIT 2	19.1449	18.0396	18.5699	19.1999	19.6614	19.8833	19.9202	19.9202	19.7852	19.1873	18.3898	18.1602	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	19.3253	18.2968	18.8045	19.4095	19.8578	20.0784	20.1181	20.1170	19.9772	19.3947	18.6303	18.4003	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3253	18.2968	18.8045	19.4095	19.8578	20.0784	20.1181	20.1170	19.9772	19.3947	18.6303	18.4003	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9719	0.9463	0.9000	0.7999	0.6421	0.4152	0.2492	0.2828	0.5954	0.8532	0.9440	0.9718	(94)
Useful gains	1282.8691	1465.9228	1671.2740	1801.8289	1584.5946	1069.6091	607.0327	628.7214	1140.2500	1315.5443	1243.8418	1199.7584	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4001.9717	3559.0182	3196.7594	2651.9565	1912.4598	1130.2607	615.6381	641.1894	1323.9281	2166.7471	2954.9884	3715.2785	(97)
Space heating kWh	2023.0124	1406.5601	1134.9612	612.0918	243.9318	0.0000	0.0000	0.0000	0.0000	633.2949	1232.0255	1871.5470	(98a)
Space heating requirement - total per year (kWh/year)												9157.4247	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2023.0124	1406.5601	1134.9612	612.0918	243.9318	0.0000	0.0000	0.0000	0.0000	633.2949	1232.0255	1871.5470	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9157.4247	
Space heating per m2											(98c) / (4) =	33.8462	(99)

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 %)												299.6518	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2023.0124	1406.5601	1134.9612	612.0918	243.9318	0.0000	0.0000	0.0000	0.0000	633.2949	1232.0255	1871.5470	(98)
Space heating efficiency (main heating system 1)	299.6518	299.6518	299.6518	299.6518	0.0000	0.0000	0.0000	0.0000	299.6518	299.6518	299.6518		(210)
Space heating fuel (main heating system)	675.1210	469.3981	378.7600	204.2677	81.4051	0.0000	0.0000	0.0000	0.0000	211.3436	411.1523	624.5738	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	351.1545	310.6452	329.6347	288.1908	278.4062	249.7625	245.3856	255.5427	258.8638	290.0365	310.1893	347.0455	(64)
Efficiency of water heater												167.8183	(216)
(217)m	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	(217)
Fuel for water heating, kWh/month	209.2468	185.1080	196.4236	171.7279	165.8974	148.8291	146.2210	152.2734	154.2524	172.8277	184.8363	206.7983	(219)
Space cooling fuel 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	(221)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Pumps and Fa	46.4763	37.2850	33.5710	24.5956	18.9983	15.5218	17.3309	22.5274	29.2608	38.3918	43.3634	47.7680	(232)
Lighting	-19.6697	-28.1421	-44.6580	-56.9358	-64.1413	-63.7055	-62.2853	-57.1380	-47.0138	-35.9610	-23.0586	-16.4427	(233a)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(234a)m	-2.7890	-5.6133	-12.1903	-21.6459	-30.4976	-35.8978	-34.9263	-29.6726	-20.7421	-10.1321	-4.2405	-2.1645	(233b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235b)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	3056.0216	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.8183	
Water heating fuel used	2094.4421	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	375.0901	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-729.6639	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4795.8899	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2444.8173	26.7600	728.5555	(240)
Space heating - main system 1 (low-rate cost)	611.2043	0.1460	89.2358	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1466.1095	29.8000	436.9006	(245)
Low-rate cost	628.3326	14.6000	91.7366	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	375.0901	28.2800	106.0755	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.1519	28.2800	-146.8162	
PV Unit electricity exported	-210.5120	5.8100	-12.2307	
Total			-159.0469	(252)
Total energy cost			1297.4571	(255)

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 (high-rate cost)	2444.8173	0.1633	399.3162	(261)
Space heating - main system 1 (low-rate cost)	611.2043	0.1371	83.8048	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1466.1095	0.1479	216.9032	(264)
Water heating - low rate cost	628.3326	0.1242	78.0180	(264)
Space and water heating			778.0421	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	375.0901	0.1490	55.8958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.1519	0.1370	-71.1185	
PV Unit electricity exported	-210.5120	0.1216	-25.5933	
Total			-96.7118	(269)
Total CO2, kg/year			737.2262	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2444.8173	1.2871	3933.3618	(275)
Space heating - main system 1 (low-rate cost)	611.2043	1.4963	914.5506	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1466.1095	1.5530	2276.8921	(278)
Water heating - low rate cost	628.3326	1.4444	907.5363	(278)
Space and water heating			8032.3408	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	375.0901	1.5547	583.1693	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-519.1519	1.5108	-784.3318	
PV Unit electricity exported	-210.5120	0.4459	-93.8746	
Total			-878.2064	(283)
Total Primary energy kWh/year			7737.3036	(286)

SAP 10 EPC IMPROVEMENTS

P3 Oakley

Current energy efficiency rating:	B 83
Current environmental impact rating:	A 97

N Solar water heating	Recommended
U Solar photovoltaic panels	Already installed
V2 Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 93	-47 kg (6.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£93	0.17 kg/m²	B 84	A 97
Total Savings	£93	0.17 kg/m²		
Potential energy efficiency rating:			B 84	
Potential environmental impact rating:				A 97

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1457	£1362	£95
Space heating	£822	£845	-£23
Water heating	£529	£411	£118
Lighting	£106	£106	£0
Generated (PV)	-£159	-£158	-£1
Total cost of fuels	£1298	£1204	£94
Total cost of uses	£1298	£1204	£94
Delivered energy	18 kWh/m²	16 kWh/m²	1 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.7 tonnes	0.0 tonnes
CO2 emissions per m²	3 kg/m²	3 kg/m²	0 kg/m²
Primary energy	29 kWh/m²	27 kWh/m²	2 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800	(1b)	x 2.5300	(2b) =	342.2584	(1b) - (3b)
First floor	135.2800	(1c)	x 2.9800	(2c) =	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		745.3928	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.3073 (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) =	0.2843 (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	0.3625	0.3553	0.3482	0.3127	0.3056	0.2701	0.2701	0.2630	0.2843	0.3056	0.3198	0.3340	(22b)
Effective ac	0.5657	0.5631	0.5606	0.5489	0.5467	0.5365	0.5365	0.5346	0.5404	0.5467	0.5511	0.5558	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		127.7070			(33)

Internal Wall 1	73.5200	100.0000	7352.0000 (32c)
Internal Wall 2	99.3900	9.0000	894.5100 (32c)
Internal Floor 1	135.5000	18.0000	2439.0000 (32d)
Internal Ceiling 1	135.5000	9.0000	1219.5000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 105.0411 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838
E3 Sill	26.7000	0.0450	1.2015
E4 Jamb	64.4000	0.0510	3.2844
E5 Ground floor (normal)	54.9200	0.0640	3.5149
E6 Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16 Corner (normal)	38.5700	0.0570	2.1985
E17 Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13 Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11 Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6 Flat ceiling	3.4200	0.1200	0.4104
E12 Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10 Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360
R7 Flat ceiling (inverted)	1.3000	0.1200	0.1560
R9 Roof to wall (flat ceiling)	1.3000	0.3200	0.4160

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.6720 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.3790 (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	139.1472	138.5198	137.9048	135.0162	134.4758	131.9599	131.9599	131.4940	132.9290	134.4758	135.5691	136.7121	(38)
Heat transfer coeff	286.5263	285.8988	285.2839	282.3953	281.8548	279.3390	279.3390	278.8731	280.3080	281.8548	282.9481	284.0912	(39)

Average = Sum(39)m / 12 = 282.3927

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0590	1.0567	1.0544	1.0437	1.0417	1.0324	1.0324	1.0307	1.0360	1.0417	1.0458	1.0500	(40)
HLP (average)												1.0437	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0937 (42)
Hot water usage for mixer showers

104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)

Hot water usage for baths

32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)

Hot water usage for other uses

46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)

Average daily hot water use (litres/day) 169.0141 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)										Total = Sum(45)m =		2807.3415	
Distribution loss (46)m = 0.15 x (45)m	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	351.1545	310.6452	328.2390	281.4372	265.6119	237.1558	232.3587	243.4463	253.4609	288.6408	310.1893	347.0455	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												655.6860	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												655.6860	
Solar input	-0.0000	-16.1617	-60.0148	-83.9564	-111.7401	-103.3699	-102.8046	-88.7423	-59.9735	-28.9228	-0.0000	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	351.1545	294.4835	268.2242	197.4808	153.8718	133.7859	129.5541	154.7040	193.4874	259.7180	310.1893	347.0455	(64)
										Total per year (kWh/year) = Sum(64)m =		2793.6991	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	144.8511	128.6632	136.5792	117.6066	110.4269	100.1467	99.2614	103.3831	108.9360	123.4128	130.3240	143.4849	(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	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)

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

	53.0979	47.1611	38.3540	29.0364	21.7051	18.3243	19.8001	25.7369	34.5440	43.8616	51.1929	54.5736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	194.6924	191.4631	183.5742	163.3426	148.4232	139.0927	133.4159	138.9557	151.3000	165.8774	181.0055	192.8560	(72)
Total internal gains													
	1014.0257	1011.5807	977.9476	912.3413	844.5750	789.0854	756.3058	761.0613	799.1498	859.1019	927.0770	985.0866	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	10.6334	0.7200	0.7000	0.7700	32.6084	(74)
East	12.9200	19.6403	0.7200	0.7000	0.7700	88.6285	(76)
West	21.6000	19.6403	0.7200	0.7000	0.7700	148.1716	(80)

Solar gains	269.4085	525.5476	868.7667	1282.6967	1592.6678	1641.1138	1557.8908	1323.1796	1014.5712	623.8424	335.4886	221.9169	(83)
Total gains	1283.4343	1537.1284	1846.7143	2195.0380	2437.2428	2430.1992	2314.1966	2084.2409	1813.7210	1482.9443	1262.5656	1207.0035	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.5522	27.6127	27.6722	27.9552	28.0088	28.2611	28.2611	28.3083	28.1634	28.0088	27.9006	27.7884	
alpha	2.8368	2.8408	2.8448	2.8637	2.8673	2.8841	2.8841	2.8872	2.8776	2.8673	2.8600	2.8526	
util living area													
	0.9824	0.9700	0.9415	0.8771	0.7678	0.6205	0.4872	0.5468	0.7655	0.9246	0.9733	0.9851	(86)
Living	18.8974	19.1294	19.5329	20.0441	20.4660	20.7337	20.8356	20.8119	20.5820	20.0047	19.3553	18.8579	
Non living	17.5347	17.8310	18.3425	18.9841	19.4890	19.7902	19.8856	19.8697	19.6383	18.9491	18.1274	17.4894	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.9244	19.1294	19.5329	20.0441	20.4660	20.7337	20.8356	20.8119	20.5820	20.0047	19.3553	19.1575	(87)
Th 2	20.0344	20.0364	20.0382	20.0470	20.0487	20.0564	20.0564	20.0578	20.0534	20.0487	20.0454	20.0419	(88)
util rest of house													
	0.9796	0.9653	0.9320	0.8566	0.7283	0.5544	0.3970	0.4556	0.7105	0.9077	0.9683	0.9828	(89)
MIT 2	19.0379	17.8310	18.3425	18.9841	19.4890	19.7902	19.8856	19.8697	19.6383	18.9491	18.1274	17.9493	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.2211	18.0993	18.5885	19.2031	19.6909	19.9852	20.0819	20.0644	19.8333	19.1673	18.3811	18.1990	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2211	18.0993	18.5885	19.2031	19.6909	19.9852	20.0819	20.0644	19.8333	19.1673	18.3811	18.1990	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9767	0.9523	0.9136	0.8348	0.7115	0.5490	0.3996	0.4562	0.6957	0.8876	0.9562	0.9765	(94)
Useful gains	1253.5687	1463.7683	1687.1336	1832.4636	1734.0619	1334.1875	924.6905	950.9268	1261.7901	1316.2475	1207.2488	1178.6986	(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													
	4275.2770	3773.6622	3448.6643	2909.5578	2252.2673	1504.2984	972.6297	1021.9017	1607.0850	2414.7254	3191.9681	3976.9940	(97)
Space heating kWh													
	2248.1509	1552.2487	1310.5788	775.5078	385.5448	0.0000	0.0000	0.0000	0.0000	817.2676	1428.9979	2081.9317	(98a)
Space heating requirement - total per year (kWh/year)												10600.2283	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2248.1509	1552.2487	1310.5788	775.5078	385.5448	0.0000	0.0000	0.0000	0.0000	817.2676	1428.9979	2081.9317	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10600.2283	
Space heating per m2											(98c) / (4) =	39.1788	(99)

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 %)	299.9045 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2248.1509	1552.2487	1310.5788	775.5078	385.5448	0.0000	0.0000	0.0000	0.0000	817.2676	1428.9979	2081.9317	(98)
Space heating efficiency (main heating system 1)													
	299.9045	299.9045	299.9045	299.9045	299.9045	0.0000	0.0000	0.0000	0.0000	299.9045	299.9045	299.9045	(210)
Space heating fuel (main heating system)													
	749.6222	517.5810	436.9987	258.5849	128.5558	0.0000	0.0000	0.0000	0.0000	272.5092	476.4843	694.1982	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	351.1545	294.4835	268.2242	197.4808	153.8718	133.7859	129.5541	154.7040	193.4874	259.7180	310.1893	347.0455	(64)
Efficiency of water heater												167.8277	(216)
(217)m	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	167.8277	(217)

Fuel for water heating, kWh/month

	209.2351	175.4678	159.8211	117.6688	91.6844	79.7162	77.1947	92.1802	115.2893	154.7528	184.8260	206.7868 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	46.4763	37.2850	33.5710	24.5956	18.9983	15.5218	17.3309	22.5274	29.2608	38.3918	43.3634	47.7680 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-17.7376	-27.9928	-44.8754	-55.6978	-63.7924	-59.0916	-58.2547	-52.7108	-43.7332	-33.8878	-20.4040	-14.9565 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-2.2970	-5.4392	-12.0631	-20.6110	-30.4807	-33.5939	-33.2059	-27.1988	-18.8520	-8.8505	-3.3599	-1.8091 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year		
Space heating fuel - main system 1	3534.5342	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.8277	
Water heating fuel used	1664.6234	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	375.0901	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4963.3520	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2827.6274	17.5600	554.2150	(240)
Space heating - main system 1 (low-rate cost)	706.9068	0.0940	66.4492	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1165.2364	19.6000	228.3863	(245)
Low-rate cost	499.3870	9.4000	46.9424	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	18.5800	14.8640	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	375.0901	18.5800	69.6917	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-493.1345	18.5800	-91.6244	
PV Unit electricity exported	-197.7613	5.5900	-11.0549	
Total			-102.6792	(252)
Total energy cost			884.8694	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	1.0095	(257)
SAP value	83.6363	
SAP rating (Section 12)	84	(258)
SAP band	B	

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 (high-rate cost)	2827.6274	0.1627	459.9884	(261)
Space heating - main system 1 (low-rate cost)	706.9068	0.1366	96.5404	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1165.2364	0.1518	176.8306	(264)
Water heating - low rate cost	499.3870	0.1274	63.6077	(264)
Space and water heating			796.9670	(265)
Pumps, fans and electric keep-hot	80.0000	0.1432	11.4562	(267)
Energy for lighting	375.0901	0.1490	55.8958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-493.1345	0.1372	-67.6601	
PV Unit electricity exported	-197.7613	0.1216	-24.0449	
Total			-91.7050	(269)
Total CO2, kg/year			772.6141	(272)
CO2 emissions per m2			2.8600	(273)
EI value			96.7192	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	135.2800 (1b)	x	2.5300 (2b)	=	342.2584	(1b) - (3b)
First floor	135.2800 (1c)	x	2.9800 (2c)	=	403.1344	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	270.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	745.3928	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	6 * 10 =	60.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	80.0000 / (5) =	0.1073	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3073	(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) =	0.2843	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2985	0.2843	0.2843	0.2630	0.2630	0.2345	0.2416	0.2274	0.2345	0.2487	0.2487	0.2701	(22b)
Effective ac	0.5445	0.5404	0.5404	0.5346	0.5346	0.5275	0.5292	0.5259	0.5275	0.5309	0.5309	0.5365	(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	
Front Door			2.5200	1.2000	3.0240			(26a)
Other Ext Door			1.9600	1.2000	2.3520			(26a)
Windows (Uw = 1.20)			43.3000	1.1450	49.5802			(27)
Heat Loss Floor 1			135.5000	0.1100	14.9050	0.0000	0.0000	(28a)
Timber Clad	222.1592	25.6200	196.5392	0.1800	35.3771	60.0000	11792.3520	(29a)
Brick/Render	80.4500	22.1600	58.2900	0.1700	9.9093	60.0000	3497.4000	(29a)
External Roof 1	5.1300		5.1300	0.1500	0.7695	9.0000	46.1700	(30)
External Roof 3	131.0000		131.0000	0.0900	11.7900	9.0000	1179.0000	(30)
Total net area of external elements Aum(A, m2)			574.2392					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		127.7070			(33)
Internal Wall 1			73.5200			100.0000	7352.0000	(32c)
Internal Wall 2			99.3900			9.0000	894.5100	(32c)
Internal Floor 1			135.5000			18.0000	2439.0000	(32d)
Internal Ceiling 1			135.5000			9.0000	1219.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28419.9320 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		105.0411 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	28.8300	0.0480	1.3838
E3	Sill	26.7000	0.0450	1.2015
E4	Jamb	64.4000	0.0510	3.2844
E5	Ground floor (normal)	54.9200	0.0640	3.5149
E6	Intermediate floor within a dwelling	54.9200	0.0000	0.0000
E16	Corner (normal)	38.5700	0.0570	2.1985
E17	Corner (inverted - internal area greater than external area)	16.5300	0.0510	0.8430
E13	Gable (insulation at rafter level)	1.0000	0.9100	0.9100
E11	Eaves (insulation at rafter level)	6.4200	0.0400	0.2568
R6	Flat ceiling	3.4200	0.1200	0.4104
E12	Gable (insulation at ceiling level)	24.1198	0.0730	1.7607
E10	Eaves (insulation at ceiling level)	24.3500	0.1370	3.3360
R7	Flat ceiling (inverted)	1.3000	0.1200	0.1560
R9	Roof to wall (flat ceiling)	1.3000	0.3200	0.4160

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		19.6720	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	147.3790	(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	133.9478	132.9290	132.9290	131.4940	131.4940	129.7547	130.1709	129.3509	129.7547	130.5995	130.5995	131.9599	(38)
Heat transfer coeff	281.3268	280.3080	280.3080	278.8731	278.8731	277.1337	277.5499	276.7299	277.1337	277.9786	277.9786	279.3390	(39)
Average = Sum(39)m / 12 =												278.6277	

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

HLP	1.0398	1.0360	1.0360	1.0307	1.0307	1.0243	1.0258	1.0228	1.0243	1.0274	1.0274	1.0324	(40)
HLP (average)												1.0298	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0937	(42)
Hot water usage for mixer showers													
	104.6243	103.0520	100.7608	96.3771	93.1420	89.5343	87.4837	89.7575	92.2500	96.1236	100.6015	104.2234	(42a)
Hot water usage for baths													
	32.8446	32.3568	31.6699	30.4033	29.4550	28.4034	27.8354	28.5175	29.2602	30.3854	31.6780	32.7335	(42b)
Hot water usage for other uses													
	46.3122	44.6281	42.9440	41.2599	39.5758	37.8918	37.8918	39.5758	41.2599	42.9440	44.6281	46.3122	(42c)
Average daily hot water use (litres/day)												169.0141	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	183.7810	180.0368	175.3747	168.0404	162.1729	155.8295	153.2108	157.8508	162.7701	169.4530	176.9076	183.2691	(44)
Energy conte	291.0641	256.3700	269.5443	230.0388	218.3158	191.6105	185.2952	195.4523	200.7118	229.9461	252.0373	286.9551	(45)
Energy content (annual)											Total = Sum(45)m =	2807.3415	
Distribution loss (46)m = 0.15 x (45)m													
	43.6596	38.4555	40.4316	34.5058	32.7474	28.7416	27.7943	29.3178	30.1068	34.4919	37.8056	43.0433	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	351.1545	310.6452	328.2390	281.4372	265.6119	237.1558	232.3587	243.4463	253.4609	288.6408	310.1893	347.0455	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												717.7642	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												717.7642	
Solar input	-0.0000	-17.5846	-61.0929	-88.7056	-113.9471	-114.2699	-112.1852	-100.5321	-69.3828	-36.1908	-3.8732	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	351.1545	293.0606	267.1461	192.7316	151.6648	122.8859	120.1735	142.9142	184.0782	252.4500	306.3161	347.0455	(64)
											Total per year (kWh/year) = Sum(64)m =	2731.6209	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	144.8511	128.6632	136.5792	117.6066	110.4269	100.1467	99.2614	103.3831	108.9360	123.4128	130.3240	143.4849	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	185.6195	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	53.0979	47.1611	38.3540	29.0364	21.7051	18.3243	19.8001	25.7369	34.5440	43.8616	51.1929	54.5736	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	647.7067	654.4278	637.4907	601.4336	555.9179	513.1396	484.5611	477.8399	494.7770	530.8342	576.3498	619.1281	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	56.6556	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	-123.7463	(71)
Water heating gains (Table 5)													
	194.6924	191.4631	183.5742	163.3426	148.4232	139.0927	133.4159	138.9557	151.3000	165.8774	181.0055	192.8560	(72)
Total internal gains													
	1014.0257	1011.5807	977.9476	912.3413	844.5750	789.0854	756.3058	761.0613	799.1498	859.1019	927.0770	985.0866	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	8.7800	11.9814	0.7200	0.7000	0.7700	36.7424	(74)
East	12.9200	22.3313	0.7200	0.7000	0.7700	100.7722	(76)
West	21.6000	22.3313	0.7200	0.7000	0.7700	168.4736	(80)

Solar gains	305.9881	537.5224	877.4305	1332.7214	1609.3764	1773.2814	1665.7305	1448.8464	1110.0536	681.2968	390.4834	249.5257	(83)
Total gains	1320.0139	1549.1032	1855.3781	2245.0627	2453.9514	2562.3667	2422.0363	2209.9076	1909.2033	1540.3987	1317.5604	1234.6122	(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	28.0614	28.1634	28.1634	28.3083	28.3083	28.4860	28.4433	28.5275	28.4860	28.3994	28.3994	28.2611	
alpha	2.8708	2.8776	2.8776	2.8872	2.8872	2.8991	2.8962	2.9018	2.8991	2.8933	2.8933	2.8841	
util living area													
	0.9786	0.9658	0.9311	0.8476	0.7064	0.4948	0.3436	0.3833	0.6766	0.8980	0.9650	0.9819	(86)
Living	19.0806	19.2842	19.7041	20.2121	20.6094	20.8267	20.8779	20.8722	20.7133	20.1903	19.5536	19.0490	
Non living	17.7792	18.0396	18.5691	19.1970	19.6589	19.8827	19.9201	19.9201	19.7844	19.1866	18.3898	17.7434	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0181	19.2842	19.7041	20.2121	20.6094	20.8267	20.8779	20.8722	20.7133	20.1903	19.5536	19.3219	(87)
Th 2	20.0503	20.0534	20.0534	20.0578	20.0578	20.0631	20.0619	20.0644	20.0631	20.0605	20.0605	20.0564	(88)
util rest of house													
	0.9751	0.9602	0.9196	0.8218	0.6562	0.4158	0.2444	0.2783	0.6041	0.8744	0.9582	0.9789	(89)
MIT 2	19.1449	18.0396	18.5691	19.1970	19.6589	19.8827	19.9201	19.9201	19.7844	19.1866	18.3898	18.1602	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	19.3253	18.2968	18.8037	19.4068	19.8553	20.0778	20.1180	20.1169	19.9764	19.3940	18.6303	18.4003	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3253	18.2968	18.8037	19.4068	19.8553	20.0778	20.1180	20.1169	19.9764	19.3940	18.6303	18.4003	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9719	0.9463	0.9002	0.8009	0.6443	0.4171	0.2506	0.2844	0.5966	0.8534	0.9440	0.9718	(94)
Useful gains	1282.8691	1465.9228	1670.2012	1798.0602	1581.0337	1068.7148	606.8736	628.4933	1139.0274	1314.6319	1243.8418	1199.7584	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4001.9717	3559.0182	3196.5378	2651.1877	1911.7674	1130.0952	615.6062	641.1444	1323.6925	2166.5593	2954.9884	3715.2785	(97)
Space heating kWh													
	2023.0124	1406.5601	1135.5945	614.2518	246.0659	0.0000	0.0000	0.0000	0.0000	633.8340	1232.0255	1871.5470	(98a)
Space heating requirement - total per year (kWh/year)												9162.8911	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2023.0124	1406.5601	1135.5945	614.2518	246.0659	0.0000	0.0000	0.0000	0.0000	633.8340	1232.0255	1871.5470	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9162.8911	
Space heating per m2											(98c) / (4) =	33.8664	(99)

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 %)												299.6518	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2023.0124	1406.5601	1135.5945	614.2518	246.0659	0.0000	0.0000	0.0000	0.0000	633.8340	1232.0255	1871.5470	(98)
Space heating efficiency (main heating system 1)													
	299.6518	299.6518	299.6518	299.6518	299.6518	0.0000	0.0000	0.0000	0.0000	299.6518	299.6518	299.6518	(210)
Space heating fuel (main heating system)													
	675.1210	469.3981	378.9713	204.9885	82.1173	0.0000	0.0000	0.0000	0.0000	211.5235	411.1523	624.5738	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	351.1545	293.0606	267.1461	192.7316	151.6648	122.8859	120.1735	142.9142	184.0782	252.4500	306.3161	347.0455	(64)
Efficiency of water heater												167.8183	(216)
(217)m	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	167.8183	(217)
Fuel for water heating, kWh/month													
	209.2468	174.6297	159.1877	114.8454	90.3744	73.2256	71.6093	85.1600	109.6890	150.4306	182.5284	206.7983	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	46.4763	37.2850	33.5710	24.5956	18.9983	15.5218	17.3309	22.5274	29.2608	38.3918	43.3634	47.7680	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.6770	-28.1390	-44.5477	-56.5207	-63.1791	-62.2938	-60.9153	-56.1102	-46.5777	-35.9069	-23.0691	-16.4487	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.7817	-5.6164	-12.3006	-22.0611	-31.4598	-37.3095	-36.2963	-30.7004	-21.1783	-10.1862	-4.2300	-2.1585	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3057.8458	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												167.8183	
Water heating fuel used												1627.7251	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												375.0901	(232)

Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation			-729.6639 (233)
Wind generation			0.0000 (234)
Hydro-electric generation (Appendix N)			0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)			0.0000 (235)
Appendix Q - special features			
Energy saved or generated			-0.0000 (236)
Energy used			0.0000 (237)
Total delivered energy for all uses			4410.9972 (238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	2446.2767	26.7600	728.9904	(240)
Space heating - main system 1 (low-rate cost)	611.5692	0.1460	89.2891	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1139.4076	29.8000	339.5435	(245)
Low-rate cost	488.3175	14.6000	71.2944	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	28.2800	22.6240	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	375.0901	28.2800	106.0755	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.3850	28.2800	-145.1853	
PV Unit electricity exported	-216.2788	5.8100	-12.5658	
Total			-157.7511	(252)
Total energy cost			1204.0658	(255)

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 (high-rate cost)	2446.2767	0.1633	399.5292	(261)
Space heating - main system 1 (low-rate cost)	611.5692	0.1371	83.8495	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1139.4076	0.1522	173.4466	(264)
Water heating - low rate cost	488.3175	0.1278	62.3911	(264)
Space and water heating			719.2163	(265)
Pumps, fans and electric keep-hot	80.0000	0.1432	11.4562	(267)
Energy for lighting	375.0901	0.1490	55.8958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.3850	0.1371	-70.3992	
PV Unit electricity exported	-216.2788	0.1212	-26.2232	
Total			-96.6224	(269)
Total CO2, kg/year			689.9459	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	2446.2767	1.2871	3935.6189	(275)
Space heating - main system 1 (low-rate cost)	611.5692	1.4963	915.0753	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1139.4076	1.5685	1787.1939	(278)
Water heating - low rate cost	488.3175	1.4588	712.3628	(278)
Space and water heating			7350.2508	(279)
Pumps, fans and electric keep-hot	80.0000	1.5335	122.6788	(281)
Energy for lighting	375.0901	1.5547	583.1693	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-513.3850	1.5113	-775.8785	
PV Unit electricity exported	-216.2788	0.4447	-96.1782	
Total			-872.0567	(283)
Total Primary energy kWh/year			7184.0422	(286)

Full SAP Calculation Printout

Property Reference	P4 Oakley	**Issued on Date**	16/01/2024
Assessment Reference	P4 Oakley	**Prop Type Ref**	Detached
Property	4, Windsor		

SAP Rating	83 B	**DER**	2.96	**TER**	7.72
Environmental	97 A	**% DER < TER**			61.66
CO_2 Emissions (t/year)	0.9	**DFEE**	41.24	**TFEE**	42.60
Compliance Check	See BREL	**% DFEE < TFEE**			3.18
% DPER < TPER	25.69	**DPER**	30.74	**TPER**	41.36

Assessor Details	Mrs. Naomi Sadler	**Assessor ID**	4611-0001
Client	Westbourne Homes, Westbourne Homes		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.5300 (2b)	=	430.6060	(1b) - (3b)
First floor	170.2000 (1c)	x	2.9800 (2c)	=	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	937.8020	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		90.0000 / (5) =	0.0960	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			4.0000	(17)
Infiltration rate			0.2960	(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) =	0.2738	(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	0.3491	0.3422	0.3354	0.3011	0.2943	0.2601	0.2601	0.2532	0.2738	0.2943	0.3080	0.3217	(22b)
Effective ac	0.5609	0.5586	0.5562	0.5453	0.5433	0.5338	0.5338	0.5321	0.5375	0.5433	0.5474	0.5517	(25)

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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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		29591.5340	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							86.9317	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019

E16 Corner (normal)	33.0600	0.0570	1.8844	
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620	
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184	
E3 Sill	29.0500	0.0450	1.3073	
E4 Jamb	90.8000	0.0510	4.6308	
E5 Ground floor (normal)	56.8900	0.0640	3.6410	
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000	
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664	
R6 Flat ceiling	16.0600	0.1200	1.9272	
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260	
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.5773 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 189.0096 (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	173.5908	172.8587	172.1411	168.7705	168.1399	165.2042	165.2042	164.6606	166.3350	168.1399	169.4156	170.7494	(38)
Heat transfer coeff	362.6005	361.8684	361.1507	357.7802	357.1495	354.2139	354.2139	353.6702	355.3447	357.1495	358.4253	359.7590	(39)

Average = Sum(39)m / 12 = 357.7771

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0652	1.0631	1.0610	1.0511	1.0492	1.0406	1.0406	1.0390	1.0439	1.0492	1.0530	1.0569	(40)
HLP (average)												1.0510	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1845 (42)

Hot water usage for mixer showers

106.7174	105.1137	102.7767	98.3053	95.0055	91.3256	89.2340	91.5533	94.0956	98.0467	102.6142	106.3085	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day) 172.3962 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	187.4586	183.6394	178.8840	171.4029	165.4179	158.9476	156.2766	161.0095	166.0273	172.8439	180.4476	186.9365	(44)
Energy conte	296.8886	261.5001	274.9380	234.6420	222.6844	195.4447	189.0031	199.3634	204.7282	234.5476	257.0807	292.6973	(45)
Energy content (annual)										Total = Sum(45)m =		2863.5180	
Distribution loss (46)m = 0.15 x (45)m	44.5333	39.2250	41.2407	35.1963	33.4027	29.3167	28.3505	29.9045	30.7092	35.1821	38.5621	43.9046	(46)

Water storage loss:

Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1880	(55)
Total storage loss	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
										Total per year (kWh/year) = Sum(64)m =		3571.0340	(64)
12Total per year (kWh/year)												3571	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	146.7878	130.3689	139.4892	124.5401	122.1149	111.5069	110.9158	114.3607	114.5937	126.0594	132.0009	145.3942	(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	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	270.6995	299.7030	270.6995	279.7228	270.6995	279.7228	270.6995	270.6995	279.7228	270.6995	279.7228	270.6995	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	490.2141	495.3010	482.4822	455.1925	420.7441	388.3676	366.7380	361.6511	374.4699	401.7596	436.2080	468.5845	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)	197.2954	194.0014	187.4855	172.9723	164.1329	154.8708	149.0804	153.7106	159.1580	169.4347	183.3346	195.4223	(72)
Total internal gains	1028.9757	1059.7722	1011.4339	978.6544	926.3433	893.7279	857.2847	856.8280	884.1175	912.6605	970.0322	1005.4731	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1409.8075	1724.5038	1964.9414	2236.1257	2405.8703	2394.2530	2290.7275	2119.4683	1941.9266	1659.0567	1429.0669	1329.5366	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.6692	22.7151	22.7602	22.9746	23.0152	23.2060	23.2060	23.2416	23.1321	23.0152	22.9333	22.8483	
alpha	2.5113	2.5143	2.5173	2.5316	2.5343	2.5471	2.5471	2.5494	2.5421	2.5343	2.5289	2.5232	
util living area	0.9801	0.9666	0.9453	0.8995	0.8210	0.6982	0.5709	0.6183	0.7955	0.9238	0.9693	0.9828	(86)
Living	18.5242	18.7817	19.1736	19.7053	20.1970	20.5772	20.7524	20.7190	20.4190	19.7735	19.0587	18.4849	
Non living	17.0773	17.4061	17.9050	18.5790	19.1842	19.6316	19.8114	19.7845	19.4611	18.6745	17.7672	17.0316	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.7335	18.7817	19.1736	19.7053	20.1970	20.5772	20.7524	20.7190	20.4190	19.7735	19.0587	18.8367	(87)
Th 2	20.0293	20.0311	20.0328	20.0410	20.0425	20.0497	20.0497	20.0510	20.0469	20.0425	20.0394	20.0362	(88)
util rest of house	0.9773	0.9618	0.9371	0.8832	0.7889	0.6373	0.4771	0.5279	0.7473	0.9084	0.9642	0.9804	(89)
MIT 2	18.8525	17.4061	17.9050	18.5790	19.1842	19.6316	19.8114	19.7845	19.4611	18.6745	17.7672	17.5731	(90)
Living area fraction									fLA = Living area / (4) =			0.1501	(91)
MIT	18.9847	17.6126	18.0955	18.7481	19.3363	19.7735	19.9527	19.9248	19.6049	18.8395	17.9611	17.7628	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9847	17.6126	18.0955	18.7481	19.3363	19.7735	19.9527	19.9248	19.6049	18.8395	17.9611	17.7628	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9736	0.9452	0.9151	0.8554	0.7604	0.6170	0.4665	0.5144	0.7203	0.8824	0.9483	0.9724	(94)
Useful gains	1372.6248	1630.0417	1798.0474	1912.8386	1829.5181	1477.3621	1068.7120	1090.1511	1398.7638	1463.9661	1355.1740	1292.7869	(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	5324.6965	4600.2971	4187.7116	3523.4636	2727.2983	1832.5369	1187.5787	1246.6202	1956.1408	2942.7375	3892.8918	4879.3382	(97)
Space heating kWh	2940.3414	1996.0116	1777.9102	1159.6500	667.9485	0.0000	0.0000	0.0000	0.0000	1100.2059	1827.1568	2668.3942	(98a)
Space heating requirement - total per year (kWh/year)												14137.6185	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2940.3414	1996.0116	1777.9102	1159.6500	667.9485	0.0000	0.0000	0.0000	0.0000	1100.2059	1827.1568	2668.3942	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14137.6185	
Space heating per m2											(98c) / (4) =	41.5324	(99)

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 %)												302.6854	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2940.3414	1996.0116	1777.9102	1159.6500	667.9485	0.0000	0.0000	0.0000	0.0000	1100.2059	1827.1568	2668.3942	(98)
Space heating efficiency (main heating system 1)	302.6854	302.6854	302.6854	302.6854	302.6854	0.0000	0.0000	0.0000	0.0000	302.6854	302.6854	302.6854	(210)
Space heating fuel (main heating system)	971.4182	659.4343	587.3789	383.1205	220.6741	0.0000	0.0000	0.0000	0.0000	363.4816	603.6488	881.5734	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
Efficiency of water heater												168.0789	(216)
(217)m	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	(217)
Fuel for water heating, kWh/month	212.3878	187.8733	199.3281	174.2004	168.2393	150.8796	148.2003	154.3643	156.4029	175.2975	187.5505	209.8942	(219)
Space cooling fuel 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	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	55.0964	44.2004	39.7975	29.1574	22.5220	18.4007	20.5453	26.7056	34.6879	45.5124	51.4062	56.6277	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.9203	-28.3860	-45.8784	-57.6248	-66.8541	-61.5300	-60.6750	-54.5753	-44.8316	-34.5214	-20.6325	-15.0911	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.1143	-5.0460	-11.0601	-18.6840	-27.4190	-31.1555	-30.7856	-25.3343	-17.7537	-8.2170	-3.1314	-1.6745	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4670.7298	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater	168.0789	
Water heating fuel used	2124.6181	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	444.6593	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6549.1114	(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 (high-rate cost)	3736.5838	0.1622	605.9920	(261)
Space heating - main system 1 (low-rate cost)	934.1460	0.1361	127.1820	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1487.2327	0.1480	220.0424	(264)
Water heating - low rate cost	637.3854	0.1242	79.1471	(264)
Space and water heating			1032.3636	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	444.6593	0.1490	66.2630	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.5205	0.1371	-69.6955	
PV Unit electricity exported	-182.3752	0.1214	-22.1411	
Total			-91.8366	(269)
Total CO2, kg/year			1006.7900	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.9600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	3736.5838	1.2838	5996.1742	(275)
Space heating - main system 1 (low-rate cost)	934.1460	1.4925	1394.1727	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1487.2327	1.5531	2309.7482	(278)
Water heating - low rate cost	637.3854	1.4444	920.6324	(278)
Space and water heating			10620.7275	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	444.6593	1.5547	691.3316	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.5205	1.5111	-768.4001	
PV Unit electricity exported	-182.3752	0.4453	-81.2123	
Total			-849.6125	(283)
Total Primary energy kWh/year			10462.4467	(286)
Dwelling Primary energy Rate (DPER)			30.7400	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.5300 (2b)	=	430.6060	(1b) - (3b)
First floor	170.2000 (1c)	x	2.9800 (2c)	=	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 340.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	937.8020	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0427	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2927	(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) = 0.2707 (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	0.3451	0.3384	0.3316	0.2978	0.2910	0.2572	0.2572	0.2504	0.2707	0.2910	0.3045	0.3181	(22b)
Effective ac	0.5596	0.5573	0.5550	0.5443	0.5423	0.5331	0.5331	0.5314	0.5366	0.5423	0.5464	0.5506	(25)

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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 Semi-glazed door			30.2200	1.0000	30.2200			(26a)
TER Opening Type (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1300	22.1260			(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1800	43.1611			(29a)
External Roof 3	170.2000		170.2000	0.1100	18.7220			(30)
External Roof 2	12.0400		12.0400	0.1100	1.3244			(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		165.3169			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 86.9317 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	40.8900	0.0600	2.4534
E16 Corner (normal)	33.0600	0.0900	2.9754
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0900	-0.9918
E1 Steel lintel with perforated steel base plate	42.0500	0.0500	2.1025
E3 Sill	29.0500	0.0500	1.4525
E4 Jamb	90.8000	0.0500	4.5400
E5 Ground floor (normal)	56.8900	0.1600	9.1024
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664
R6 Flat ceiling	16.0600	0.0600	0.9636
R7 Flat ceiling (inverted)	1.0500	0.0400	0.0420
R9 Roof to wall (flat ceiling)	1.0500	0.0400	0.0420

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3484 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 188.6653 (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	173.1707	172.4549	171.7533	168.4578	167.8413	164.9710	164.9710	164.4395	166.0766	167.8413	169.0886	170.3926	(38)
Heat transfer coeff	361.8360	361.1202	360.4186	357.1231	356.5065	353.6363	353.6363	353.1047	354.7418	356.5065	357.7538	359.0578	(39)
Average = Sum(39)m / 12 =												357.1201	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0630	1.0609	1.0588	1.0491	1.0473	1.0389	1.0389	1.0373	1.0421	1.0473	1.0510	1.0548	(40)
HLP (average)												1.0491	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1845 (42)
Hot water usage for mixer showers

77.6127	76.4463	74.7467	71.4948	69.0949	66.4186	64.8974	66.5842	68.4332	71.3067	74.6285	77.3153	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day) 145.5626 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	158.3538	154.9721	150.8539	144.5924	139.5074	134.0406	131.9401	136.0405	140.3648	146.1039	152.4620	157.9432	(44)
Energy conte	250.7938	220.6782	231.8569	197.9397	187.8037	164.8186	159.5701	168.4465	173.0839	198.2616	217.2100	247.3009	(45)
Energy content (annual)										Total = Sum(45)m =		2417.7639	
Distribution loss (46)m = 0.15 x (45)m	37.6191	33.1017	34.7785	29.6910	28.1706	24.7228	23.9355	25.2670	25.9626	29.7392	32.5815	37.0951	(46)
Water storage loss:													
Store volume												400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.5234	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.3626	(55)
Total storage loss	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(56)
If cylinder contains dedicated solar storage	42.2417	38.1538	42.2417	40.8791	42.2417	40.8791	42.2417	42.2417	40.8791	42.2417	40.8791	42.2417	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	316.2979	279.8432	297.3610	261.3308	253.3078	228.2097	225.0742	233.9506	236.4750	263.7657	280.6011	312.8050	(62)
WWHRS	-35.4813	-31.3799	-32.8593	-27.2088	-25.3576	-21.6987	-20.3390	-21.6285	-22.4503	-26.4664	-29.9832	-34.8242	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	280.8166	248.4632	264.5018	234.1220	227.9502	206.5110	204.7352	212.3221	214.0247	237.2993	250.6179	277.9808	(64)
										Total per year (kWh/year) = Sum(64)m =		2859.3449	(64)
12Total per year (kWh/year)												2859	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	135.7922	120.7075	129.4957	116.5278	114.8480	105.5151	105.4604	108.4118	108.2633	118.3253	122.9352	134.6308	(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	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	270.6995	299.7030	270.6995	279.7228	270.6995	279.7228	270.6995	270.6995	279.7228	270.6995	279.7228	270.6995	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	490.2141	495.3010	482.4822	455.1925	420.7441	388.3676	366.7380	361.6511	374.4699	401.7596	436.2080	468.5845	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	182.5164	179.6242	174.0534	161.8442	154.3656	146.5487	141.7478	145.7147	150.3656	159.0394	170.7433	180.9554	(72)
Total internal gains													
	1017.1968	1048.3950	1001.0018	970.5263	919.5760	885.4058	849.9521	848.8321	875.3251	905.2652	960.4409	994.0062	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.6300	0.7000	0.7700	59.7295	(74)
East	5.9900	19.6403	0.6300	0.7000	0.7700	35.9539	(76)
South	14.8400	46.7521	0.6300	0.7000	0.7700	212.0345	(78)
West	4.2500	19.6403	0.6300	0.7000	0.7700	25.5099	(80)

Solar gains	333.2278	581.6402	834.3190	1100.2874	1294.5862	1312.9595	1254.2624	1104.8103	925.5830	653.0967	401.6553	283.5556	(83)
Total gains	1350.4246	1630.0352	1835.3209	2070.8137	2214.1622	2198.3653	2104.2145	1953.6424	1800.9081	1558.3619	1362.0962	1277.5619	(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	22.7171	22.7621	22.8065	23.0169	23.0567	23.2439	23.2439	23.2788	23.1714	23.0567	22.9763	22.8929	
alpha	2.5145	2.5175	2.5204	2.5345	2.5371	2.5496	2.5496	2.5519	2.5448	2.5371	2.5318	2.5262	
util living area													
	0.9820	0.9704	0.9524	0.9128	0.8431	0.7286	0.6037	0.6495	0.8175	0.9326	0.9724	0.9843	(86)
MIT	17.8296	18.1528	18.6583	19.3571	20.0203	20.5512	20.8062	20.7587	20.3389	19.4754	18.5362	17.7804	(87)
Th 2	20.0312	20.0329	20.0346	20.0426	20.0441	20.0511	20.0511	20.0523	20.0484	20.0441	20.0411	20.0379	(88)
util rest of house													
	0.9794	0.9661	0.9452	0.8983	0.8135	0.6697	0.5090	0.5593	0.7722	0.9186	0.9677	0.9821	(89)
MIT 2	16.2624	16.6750	17.3189	18.2049	19.0257	19.6545	19.9210	19.8808	19.4227	18.3645	17.1713	16.2030	(90)
Living area fraction									fLA = Living area / (4) =			0.1501	(91)
MIT	16.4977	16.8969	17.5200	18.3779	19.1750	19.7891	20.0539	20.0126	19.5603	18.5313	17.3763	16.4398	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.4977	16.8969	17.5200	18.3779	19.1750	19.7891	20.0539	20.0126	19.5603	18.5313	17.3763	16.4398	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9641	0.9450	0.9177	0.8644	0.7801	0.6509	0.5093	0.5550	0.7435	0.8873	0.9475	0.9683	(94)
Useful gains	1301.9601	1540.3628	1684.2972	1789.9486	1727.3587	1430.8146	1071.6495	1084.3684	1339.0120	1382.7274	1290.5300	1237.0697	(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													
	4413.5607	4332.3119	3971.8151	3384.7829	2664.8988	1835.0518	1221.4133	1275.6258	1936.9823	2827.5689	3676.3710	4394.8001	(97)
Space heating kWh													
	2315.0309	1876.1898	1701.9133	1148.2807	697.5298	0.0000	0.0000	0.0000	0.0000	1074.9621	1717.8055	2349.3514	(98a)
Space heating requirement - total per year (kWh/year)												12881.0636	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2315.0309	1876.1898	1701.9133	1148.2807	697.5298	0.0000	0.0000	0.0000	0.0000	1074.9621	1717.8055	2349.3514	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12881.0636	
Space heating per m2											(98c) / (4) =	37.8410	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2315.0309	1876.1898	1701.9133	1148.2807	697.5298	0.0000	0.0000	0.0000	0.0000	1074.9621	1717.8055	2349.3514	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	2508.1591	2032.7083	1843.8931	1244.0744	755.7203	0.0000	0.0000	0.0000	0.0000	1164.6393	1861.1111	2545.3428	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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

	280.8166	248.4632	264.5018	234.1220	227.9502	206.5110	204.7352	212.3221	214.0247	237.2993	250.6179	277.9808	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7296	87.6441	87.4730	87.1357	86.3999	79.8000	79.8000	79.8000	79.8000	87.0252	87.5429	87.7529	(217)
Fuel for water heating, kWh/month													
	320.0932	283.4913	302.3810	268.6868	263.8316	258.7857	256.5604	266.0678	268.2014	272.6790	286.2799	316.7769	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	56.2460	45.1226	40.6279	29.7658	22.9919	18.7846	20.9740	27.2628	35.4117	46.4621	52.4788	57.8093	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-131.2815	-172.4335	-230.8711	-240.8924	-244.5897	-222.5746	-219.3022	-213.8870	-202.9942	-187.2612	-139.5079	-114.9936	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-117.9248	-241.3304	-468.0365	-687.0430	-893.9367	-893.4833	-883.4045	-754.8541	-562.3245	-340.1335	-155.6795	-93.8214	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	13955.6485	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3363.8349	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	453.9376	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-8412.5614	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	9446.8596	(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	13955.6485	0.2100	2930.6862	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3363.8349	0.2100	706.4053	(264)
Space and water heating			3637.0915	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	453.9376	0.1443	65.5172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2320.5891	0.1362	-316.0943	
PV Unit electricity exported	-6091.9723	0.1266	-771.0785	
Total			-1087.1728	(269)
Total CO2, kg/year			2627.3652	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7200	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	13955.6485	1.1300	15769.8828	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3363.8349	1.1300	3801.1335	(278)
Space and water heating			19571.0163	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	453.9376	1.5338	696.2646	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2320.5891	1.5035	-3489.0269	
PV Unit electricity exported	-6091.9723	0.4646	-2830.5637	
Total			-6319.5906	(283)
Total Primary energy kWh/year			14077.7911	(286)
Target Primary Energy Rate (TPER)			41.3600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.5300 (2b)	=	430.6060	(1b) - (3b)
First floor	170.2000 (1c)	x	2.9800 (2c)	=	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 340.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	937.8020	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0427	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2427	(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) =	0.2245	(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	0.2862	0.2806	0.2750	0.2469	0.2413	0.2132	0.2132	0.2076	0.2245	0.2413	0.2525	0.2637	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5409	0.5394	0.5378	0.5305	0.5291	0.5227	0.5227	0.5216	0.5252	0.5291	0.5319	0.5348	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29591.5340 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		86.9317 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019
E16 Corner (normal)	33.0600	0.0570	1.8844
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184
E3 Sill	29.0500	0.0450	1.3073
E4 Jamb	90.8000	0.0510	4.6308
E5 Ground floor (normal)	56.8900	0.0640	3.6410
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664
R6 Flat ceiling	16.0600	0.1200	1.9272
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		21.5773 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	189.0096 (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	167.4101	166.9180	166.4356	164.1700	163.7461	161.7729	161.7729	161.4074	162.5329	163.7461	164.6036	165.5001	(38)
Heat transfer coeff	356.4197	355.9276	355.4452	353.1796	352.7558	350.7825	350.7825	350.4171	351.5426	352.7558	353.6133	354.5098	(39)
Average = Sum(39)m / 12 =												353.1776	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0471	1.0456	1.0442	1.0375	1.0363	1.0305	1.0305	1.0294	1.0327	1.0363	1.0388	1.0415	(40)
HLP (average)												1.0375	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1845 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day)	74.0063 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	80.7412	78.5258	76.1073	73.0976	70.4124	67.6220	67.0427	69.4563	71.9316	74.7972	77.8335	80.6279	(44)

Energy conte	127.8743	111.8196	116.9740	100.0670	94.7887	83.1492	81.0823	86.0014	88.6989	101.4991	110.8880	126.2438	(45)
Energy content (annual)										Total = Sum(45)m =		1229.0863	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	108.6931	95.0467	99.4279	85.0569	80.5704	70.6768	68.9200	73.1012	75.3941	86.2742	94.2548	107.3072	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	108.6931	95.0467	99.4279	85.0569	80.5704	70.6768	68.9200	73.1012	75.3941	86.2742	94.2548	107.3072	(64)
										Total per year (kWh/year) = Sum(64)m =		1044.7233	(64)
12Total per year (kWh/year)												1045	(64)
Electric shower(s)													
	62.1548	55.3805	60.4733	57.7090	58.7918	56.0817	57.9511	58.7918	57.7090	60.4733	59.3362	62.1548	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		707.0074	(64a)
Heat gains from water heating, kWh/month													
	42.7120	37.6068	39.9753	35.6915	34.8406	31.6896	31.7178	32.9733	33.2758	36.6869	38.3978	42.3655	(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	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	270.6995	299.7030	270.6995	279.7228	270.6995	279.7228	270.6995	270.6995	279.7228	270.6995	279.7228	270.6995	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	490.2141	495.3010	482.4822	455.1925	420.7441	388.3676	366.7380	361.6511	374.4699	401.7596	436.2080	468.5845	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	57.4086	55.9625	53.7303	49.5715	46.8287	44.0134	42.6314	44.3189	46.2163	49.3103	53.3302	56.9429	(72)
Total internal gains													
	889.0889	921.7332	877.6787	855.2536	809.0391	782.8705	750.8357	747.4363	771.1758	792.5362	840.0278	866.9937	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1269.9207	1586.4649	1831.1862	2112.7249	2288.5662	2283.3956	2184.2785	2010.0767	1828.9849	1538.9324	1299.0624	1191.0573	(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	23.0623	23.0942	23.1256	23.2739	23.3019	23.4330	23.4330	23.4574	23.3823	23.3019	23.2454	23.1866	
alpha	2.5375	2.5396	2.5417	2.5516	2.5535	2.5622	2.5622	2.5638	2.5588	2.5535	2.5497	2.5458	
util living area													
	0.9843	0.9720	0.9523	0.9087	0.8330	0.7132	0.5866	0.6363	0.8116	0.9338	0.9750	0.9867	(86)
MIT	17.8196	18.1655	18.6910	19.4022	20.0665	20.5802	20.8216	20.7733	20.3598	19.4843	18.5243	17.7595	(87)
Th 2	20.0443	20.0455	20.0467	20.0522	20.0532	20.0580	20.0580	20.0589	20.0561	20.0532	20.0511	20.0489	(88)
util rest of house													
	0.9821	0.9680	0.9451	0.8938	0.8024	0.6535	0.4929	0.5465	0.7657	0.9201	0.9708	0.9848	(89)
MIT 2	17.0924	17.4366	17.9582	18.6602	19.2990	19.7704	19.9652	19.9339	19.5846	18.7500	17.7993	17.0354	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	17.2016	17.5461	18.0682	18.7716	19.4142	19.8920	20.0938	20.0599	19.7010	18.8603	17.9082	17.1441	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2016	17.5461	18.0682	18.7716	19.4142	19.8920	20.0938	20.0599	19.7010	18.8603	17.9082	17.1441	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9721	0.9530	0.9247	0.8679	0.7776	0.6415	0.4969	0.5466	0.7450	0.8969	0.9569	0.9759	(94)
Useful gains	1234.4393	1511.9048	1693.3623	1833.7378	1779.6936	1464.8542	1085.2894	1098.7713	1362.5660	1380.2521	1243.1057	1162.3598	(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													
	4598.3773	4501.0893	4111.8595	3486.4372	2721.2459	1856.3360	1225.5655	1282.4893	1968.9782	2913.8522	3821.9188	4588.8248	(97)
Space heating kWh													
	2502.7698	2008.7320	1799.3619	1189.9435	700.5150	0.0000	0.0000	0.0000	0.0000	1140.9985	1856.7454	2549.2900	(98a)
Space heating requirement - total per year (kWh/year)												13748.3561	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2502.7698	2008.7320	1799.3619	1189.9435	700.5150	0.0000	0.0000	0.0000	0.0000	1140.9985	1856.7454	2549.2900	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13748.3561	

Space heating per m2 (98c) / (4) = 40.3888 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3297.3555	2595.7905	2663.1698	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6178	0.6924	0.6503	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2037.0296	1797.3123	1731.8717	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2522.1923	2412.0269	2214.1565	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	349.3171	457.3477	358.8199	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)

	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	87.3293	114.3369	89.7050	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 291.3712 (107)
Energy for space heating 40.3888 (99)
Energy for space cooling 0.8560 (108)
Total 41.2448 (109)
Fabric Energy Efficiency (DFEE) 41.2 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.5300 (2b)	=	430.6060 (1b) - (3b)	
First floor	170.2000 (1c)	x	2.9800 (2c)	=	507.1960 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	937.8020	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0427 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2927 (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) =	0.2707 (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	0.3451	0.3384	0.3316	0.2978	0.2910	0.2572	0.2572	0.2504	0.2707	0.2910	0.3045	0.3181	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.5596	0.5573	0.5550	0.5443	0.5423	0.5331	0.5331	0.5314	0.5366	0.5423	0.5464	0.5506	(25)

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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 Semi-glazed door			30.2200	1.0000	30.2200			(26a)
TER Opening Type (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1300	22.1260			(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1800	43.1611			(29a)
External Roof 3	170.2000		170.2000	0.1100	18.7220			(30)
External Roof 2	12.0400		12.0400	0.1100	1.3244			(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		165.3169			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 86.9317 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	40.8900	0.0600	2.4534

E16 Corner (normal)	33.0600	0.0900	2.9754
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0900	-0.9918
E1 Steel lintel with perforated steel base plate	42.0500	0.0500	2.1025
E3 Sill	29.0500	0.0500	1.4525
E4 Jamb	90.8000	0.0500	4.5400
E5 Ground floor (normal)	56.8900	0.1600	9.1024
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664
R6 Flat ceiling	16.0600	0.0600	0.9636
R7 Flat ceiling (inverted)	1.0500	0.0400	0.0420
R9 Roof to wall (flat ceiling)	1.0500	0.0400	0.0420

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3484 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 188.6653 (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	173.1707	172.4549	171.7533	168.4578	167.8413	164.9710	164.9710	164.4395	166.0766	167.8413	169.0886	170.3926	(38)
Heat transfer coeff	361.8360	361.1202	360.4186	357.1231	356.5065	353.6363	353.6363	353.1047	354.7418	356.5065	357.7538	359.0578	(39)

Average = Sum(39)m / 12 = 357.1201

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0630	1.0609	1.0588	1.0491	1.0473	1.0389	1.0389	1.0373	1.0421	1.0473	1.0510	1.0548	(40)
HLP (average)												1.0491	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1845 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day) 74.0063 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	80.7412	78.5258	76.1073	73.0976	70.4124	67.6220	67.0427	69.4563	71.9316	74.7972	77.8335	80.6279	(44)
Energy conte	127.8743	111.8196	116.9740	100.0670	94.7887	83.1492	81.0823	86.0014	88.6989	101.4991	110.8880	126.2438	(45)

Energy content (annual) Total = Sum(45)m = 1229.0863

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

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

108.6931	95.0467	99.4279	85.0569	80.5704	70.6768	68.9200	73.1012	75.3941	86.2742	94.2548	107.3072	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

108.6931	95.0467	99.4279	85.0569	80.5704	70.6768	68.9200	73.1012	75.3941	86.2742	94.2548	107.3072	(64)

Total per year (kWh/year) = Sum(64)m = 1044.7233 (64)

12Total per year (kWh/year) 1045 (64)

Electric shower(s)

62.1548	55.3805	60.4733	57.7090	58.7918	56.0817	57.9511	58.7918	57.7090	60.4733	59.3362	62.1548	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 707.0074 (64a)

Heat gains from water heating, kWh/month

42.7120	37.6068	39.9753	35.6915	34.8406	31.6896	31.7178	32.9733	33.2758	36.6869	38.3978	42.3655	(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	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	159.2225	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	270.6995	299.7030	270.6995	279.7228	270.6995	279.7228	270.6995	270.6995	279.7228	270.6995	279.7228	270.6995	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	490.2141	495.3010	482.4822	455.1925	420.7441	388.3676	366.7380	361.6511	374.4699	401.7596	436.2080	468.5845	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	38.9222	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)	57.4086	55.9625	53.7303	49.5715	46.8287	44.0134	42.6314	44.3189	46.2163	49.3103	53.3302	56.9429	(72)
Total internal gains	889.0889	921.7332	877.6787	855.2536	809.0391	782.8705	750.8357	747.4363	771.1758	792.5362	840.0278	866.9937	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.6300	0.7000	0.7700	59.7295	(74)
East	5.9900	19.6403	0.6300	0.7000	0.7700	35.9539	(76)
South	14.8400	46.7521	0.6300	0.7000	0.7700	212.0345	(78)
West	4.2500	19.6403	0.6300	0.7000	0.7700	25.5099	(80)

Solar gains	333.2278	581.6402	834.3190	1100.2874	1294.5862	1312.9595	1254.2624	1104.8103	925.5830	653.0967	401.6553	283.5556	(83)
Total gains	1222.3167	1503.3735	1711.9977	1955.5410	2103.6253	2095.8300	2005.0981	1852.2466	1696.7588	1445.6329	1241.6831	1150.5493	(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	22.7171	22.7621	22.8065	23.0169	23.0567	23.2439	23.2439	23.2788	23.1714	23.0567	22.9763	22.8929	
alpha	2.5145	2.5175	2.5204	2.5345	2.5371	2.5496	2.5496	2.5519	2.5448	2.5371	2.5318	2.5262	
util living area	0.9856	0.9752	0.9588	0.9219	0.8559	0.7453	0.6226	0.6699	0.8340	0.9420	0.9775	0.9877	(86)
MIT	17.7481	18.0750	18.5866	19.2980	19.9755	20.5242	20.7913	20.7396	20.3002	19.4135	18.4614	17.6987	(87)
Th 2	20.0312	20.0329	20.0346	20.0426	20.0441	20.0511	20.0511	20.0523	20.0484	20.0441	20.0411	20.0379	(88)
util rest of house	0.9835	0.9716	0.9525	0.9086	0.8279	0.6876	0.5276	0.5802	0.7911	0.9297	0.9736	0.9859	(89)
MIT 2	17.0132	17.3392	17.8482	18.5541	19.2101	19.7209	19.9407	19.9064	19.5280	18.6760	17.7309	16.9681	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	17.1235	17.4497	17.9590	18.6658	19.3250	19.8415	20.0684	20.0315	19.6439	18.7867	17.8406	17.0778	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.1235	17.4497	17.9590	18.6658	19.3250	19.8415	20.0684	20.0315	19.6439	18.7867	17.8406	17.0778	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9576	0.9334	0.8836	0.8021	0.6729	0.5295	0.5780	0.7686	0.9074	0.9605	0.9775	(94)
Useful gains	1190.5706	1439.5983	1597.9506	1727.8257	1687.2497	1410.3193	1061.7354	1070.5967	1304.1936	1311.7459	1192.6449	1124.6196	(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	4640.0041	4531.9434	4130.0520	3487.5848	2718.3775	1853.6010	1226.5658	1282.3118	1966.6627	2918.6230	3842.4884	4623.8820	(97)
Space heating kWh	2566.3785	2078.0559	1883.8834	1267.0265	767.1591	0.0000	0.0000	0.0000	0.0000	1195.5166	1907.8873	2603.4512	(98a)
Space heating requirement - total per year (kWh/year)												14269.3586	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2566.3785	2078.0559	1883.8834	1267.0265	767.1591	0.0000	0.0000	0.0000	0.0000	1195.5166	1907.8873	2603.4512	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14269.3586	
Space heating per m2											(98c) / (4) =	41.9194	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3324.1809	2616.9083	2683.5960	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5781	0.6540	0.6127	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1921.8479	1711.5535	1644.2451	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2302.9597	2202.5954	2029.6799	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	274.4005	365.3352	286.7635	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	68.6001	91.3338	71.6909	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												231.6248	(107)
Energy for space heating												41.9194	(99)
Energy for space cooling												0.6804	(108)
Total												42.5998	(109)
Fabric Energy Efficiency (TFEE)												42.6	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.5300	(2b) =	430.6060	(1b) - (3b)
First floor	170.2000	(1c)	x 2.9800	(2c) =	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		937.8020	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0960 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.2960 (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) =	0.2738 (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	0.3491	0.3422	0.3354	0.3011	0.2943	0.2601	0.2601	0.2532	0.2738	0.2943	0.3080	0.3217	(22b)
Effective ac	0.5609	0.5586	0.5562	0.5453	0.5433	0.5338	0.5338	0.5321	0.5375	0.5433	0.5474	0.5517	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29591.5340 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		86.9317 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019
E16 Corner (normal)	33.0600	0.0570	1.8844
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184
E3 Sill	29.0500	0.0450	1.3073
E4 Jamb	90.8000	0.0510	4.6308
E5 Ground floor (normal)	56.8900	0.0640	3.6410
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664
R6 Flat ceiling	16.0600	0.1200	1.9272
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		21.5773 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	189.0096 (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	173.5908	172.8587	172.1411	168.7705	168.1399	165.2042	165.2042	164.6606	166.3350	168.1399	169.4156	170.7494	(38)
Heat transfer coeff	362.6005	361.8684	361.1507	357.7802	357.1495	354.2139	354.2139	353.6702	355.3447	357.1495	358.4253	359.7590	(39)
Average = Sum(39)m / 12 =												357.7771	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0652	1.0631	1.0610	1.0511	1.0492	1.0406	1.0406	1.0390	1.0439	1.0492	1.0530	1.0569	(40)
HLP (average)												1.0510	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1845 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
106.7174	105.1137	102.7767	98.3053	95.0055	91.3256	89.2340	91.5533	94.0956	98.0467	102.6142	106.3085	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day)		172.3962 (43)

Daily hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
187.4586	183.6394	178.8840	171.4029	165.4179	158.9476	156.2766	161.0095	166.0273	172.8439	180.4476	186.9365	(44)
Energy conte 296.8886	261.5001	274.9380	234.6420	222.6844	195.4447	189.0031	199.3634	204.7282	234.5476	257.0807	292.6973	(45)

Energy content (annual)	Total = Sum(45)m =	2863.5180

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

44.5333	39.2250	41.2407	35.1963	33.4027	29.3167	28.3505	29.9045	30.7092	35.1821	38.5621	43.9046	(46)

Water storage loss:		
Store volume		400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		2.2000 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.1880 (55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)

PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
											Total per year (kWh/year) = Sum(64)m =	3571.0340	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	146.7878	130.3689	139.4892	124.5401	122.1149	111.5069	110.9158	114.3607	114.5937	126.0594	132.0009	145.3942	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.9461	55.9082	45.4676	34.4219	25.7308	21.7230	23.4725	30.5104	40.9510	51.9967	60.6878	64.6956	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	197.2954	194.0014	187.4855	172.9723	164.1329	154.8708	149.0804	153.7106	159.1580	169.4347	183.3346	195.4223	(72)
Total internal gains													
	1112.8845	1110.1449	1074.0559	1007.7661	938.8201	877.2270	840.9032	844.9789	879.9995	942.0527	1016.0593	1080.4779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1493.7162	1774.8766	2027.5633	2265.2374	2418.3472	2377.7521	2274.3460	2107.6193	1937.8086	1688.4489	1475.0939	1404.5415	(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	22.6692	22.7151	22.7602	22.9746	23.0152	23.2060	23.2060	23.2416	23.1321	23.0152	22.9333	22.8483	
alpha	2.5113	2.5143	2.5173	2.5316	2.5343	2.5471	2.5471	2.5494	2.5421	2.5343	2.5289	2.5232	
util living area													
	0.9774	0.9644	0.9417	0.8970	0.8196	0.7007	0.5737	0.6205	0.7961	0.9212	0.9671	0.9806	(86)
Living	18.5636	18.8043	19.1998	19.7158	20.2004	20.5744	20.7509	20.7176	20.4179	19.7851	19.0796	18.5206	
Non living	17.1273	17.4347	17.9377	18.5917	19.1881	19.6288	19.8103	19.7834	19.4600	18.6885	17.7936	17.0770	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.7536	18.8043	19.1998	19.7158	20.2004	20.5744	20.7509	20.7176	20.4179	19.7851	19.0796	18.8674	(87)
Th 2	20.0293	20.0311	20.0328	20.0410	20.0425	20.0497	20.0497	20.0510	20.0469	20.0425	20.0394	20.0362	(88)
util rest of house													
	0.9742	0.9594	0.9331	0.8805	0.7873	0.6399	0.4798	0.5301	0.7480	0.9053	0.9617	0.9778	(89)
MIT 2	18.8724	17.4347	17.9377	18.5917	19.1881	19.6288	19.8103	19.7834	19.4600	18.6885	17.7936	17.6102	(90)
Living area fraction											fLA = Living area / (4) =	0.1501	(91)
MIT	19.0047	17.6403	18.1272	18.7605	19.3401	19.7708	19.9515	19.9237	19.6038	18.8531	17.9867	17.7990	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0047	17.6403	18.1272	18.7605	19.3401	19.7708	19.9515	19.9237	19.6038	18.8531	17.9867	17.7990	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9702	0.9422	0.9103	0.8526	0.7589	0.6195	0.4691	0.5164	0.7210	0.8790	0.9451	0.9690	(94)
Useful gains	1449.1766	1672.2776	1845.7828	1931.2659	1835.2438	1473.1103	1066.8284	1088.3418	1397.1314	1484.2224	1394.0994	1361.0496	(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													
	5331.9401	4610.3220	4199.1658	3527.8936	2728.6560	1831.5735	1187.1644	1246.2179	1955.7568	2947.6034	3902.0677	4892.3625	(97)
Space heating kWh													
	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98a)
Space heating requirement - total per year (kWh/year)												13950.1189	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13950.1189	
Space heating per m2											(98c) / (4) =	40.9815	(99)

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 %)	302.6854	(206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98)
Space heating efficiency (main heating system 1)													
	302.6854	302.6854	302.6854	302.6854	302.6854	0.0000	0.0000	0.0000	0.0000	302.6854	302.6854	302.6854	(210)
Space heating fuel (main heating system)													
	954.3823	652.2831	578.4609	379.7910	219.6005	0.0000	0.0000	0.0000	0.0000	359.6987	596.5722	867.9958	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
Efficiency of water heater												168.0789	(216)
(217)m	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	(217)
Fuel for water heating, kWh/month													
	212.3878	187.8733	199.3281	174.2004	168.2393	150.8796	148.2003	154.3643	156.4029	175.2975	187.5505	209.8942	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	55.0964	44.2004	39.7975	29.1574	22.5220	18.4007	20.5453	26.7056	34.6879	45.5124	51.4062	56.6277	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.9112	-28.3748	-45.8483	-57.6019	-66.8416	-61.5300	-60.6750	-54.5753	-44.8316	-34.5090	-20.6252	-15.0850	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.1234	-5.0572	-11.0902	-18.7069	-27.4315	-31.1555	-30.7856	-25.3343	-17.7537	-8.2293	-3.1387	-1.6806	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 4608.7844 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 168.0789
Water heating fuel used 2124.6181 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 0.0000 (231)
Electricity for lighting (calculated in Appendix L) 444.6593 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -690.8958 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 6487.1661 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3687.0275	17.5600	722.6574	(240)
Space heating - main system 1 (low-rate cost)	921.7569	0.0940	86.6451	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1487.2327	19.6000	291.4976	(245)
Low-rate cost	637.3854	9.4000	59.9142	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	444.6593	18.5800	82.6177	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.4089	18.5800	-94.4624	
PV Unit electricity exported	-182.4868	5.5900	-10.2010	
Total			-104.6634	(252)
Total energy cost			1145.6687	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.0702 (257)
SAP value 82.6527
SAP rating (Section 12) 83 (258)
SAP band B

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 (high-rate cost)	3687.0275	0.1621	597.8490	(261)

Space heating - main system 1 (low-rate cost)	921.7569	0.1361	125.4735	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1487.2327	0.1480	220.0424	(264)
Water heating - low rate cost	637.3854	0.1242	79.1471	(264)
Space and water heating			1022.5120	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	444.6593	0.1490	66.2630	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.4089	0.1371	-69.6783	
PV Unit electricity exported	-182.4868	0.1214	-22.1596	
Total			-91.8379	(269)
Total CO2, kg/year			996.9371	(272)
CO2 emissions per m2			2.9300	(273)
EI value			96.5337	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.5300	(2b) =	430.6060	(1b) - (3b)
First floor	170.2000	(1c)	x 2.9800	(2c) =	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		937.8020	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	1 * 20 =	20.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0960	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2960	(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) =	0.2738	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2875	0.2738	0.2738	0.2532	0.2532	0.2259	0.2327	0.2190	0.2259	0.2395	0.2395	0.2601	(22b)
Effective ac	0.5413	0.5375	0.5375	0.5321	0.5321	0.5255	0.5271	0.5240	0.5255	0.5287	0.5287	0.5338	(25)

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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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29591.5340 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		86.9317 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019
E16 Corner (normal)	33.0600	0.0570	1.8844
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184
E3 Sill	29.0500	0.0450	1.3073
E4 Jamb	90.8000	0.0510	4.6308
E5 Ground floor (normal)	56.8900	0.0640	3.6410

E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000	
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664	
R6 Flat ceiling	16.0600	0.1200	1.9272	
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260	
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.5773 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 189.0096 (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	167.5238	166.3350	166.3350	164.6606	164.6606	162.6310	163.1167	162.1598	162.6310	163.6168	163.6168	165.2042	(38)
Heat transfer coeff	356.5334	355.3447	355.3447	353.6702	353.6702	351.6406	352.1263	351.1695	351.6406	352.6264	352.6264	354.2139	(39)
Average = Sum(39)m / 12 =												353.3839	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0474	1.0439	1.0439	1.0390	1.0390	1.0330	1.0344	1.0316	1.0330	1.0359	1.0359	1.0406	(40)
HLP (average)												1.0381	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1845 (42)
Hot water usage for mixer showers

106.7174	105.1137	102.7767	98.3053	95.0055	91.3256	89.2340	91.5533	94.0956	98.0467	102.6142	106.3085	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day) 172.3962 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	187.4586	183.6394	178.8840	171.4029	165.4179	158.9476	156.2766	161.0095	166.0273	172.8439	180.4476	186.9365	(44)
Energy conte	296.8886	261.5001	274.9380	234.6420	222.6844	195.4447	189.0031	199.3634	204.7282	234.5476	257.0807	292.6973	(45)
Energy content (annual)											Total = Sum(45)m =	2863.5180	
Distribution loss (46)m = 0.15 x (45)m	44.5333	39.2250	41.2407	35.1963	33.4027	29.3167	28.3505	29.9045	30.7092	35.1821	38.5621	43.9046	(46)

Water storage loss:
Store volume 400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.2000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1880 (55)
Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(57)
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)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)

Total per year (kWh/year) = Sum(64)m = 3571.0340 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

146.7878	130.3689	139.4892	124.5401	122.1149	111.5069	110.9158	114.3607	114.5937	126.0594	132.0009	145.3942	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.9461	55.9082	45.4676	34.4219	25.7308	21.7230	23.4725	30.5104	40.9510	51.9967	60.6878	64.6956	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)	197.2954	194.0014	187.4855	172.9723	164.1329	154.8708	149.0804	153.7106	159.1580	169.4347	183.3346	195.4223	(72)
Total internal gains	1112.8845	1110.1449	1074.0559	1007.7661	938.8201	877.2270	840.9032	844.9789	879.9995	942.0527	1016.0593	1080.4779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	11.9814	0.7200	0.7000	0.7700	76.9163	(74)
East	5.9900	22.3313	0.7200	0.7000	0.7700	46.7202	(76)
South	14.8400	50.9848	0.7200	0.7000	0.7700	264.2644	(78)
West	4.2500	22.3313	0.7200	0.7000	0.7700	33.1487	(80)

Solar gains	421.0496	662.3946	942.4501	1288.5368	1483.5446	1612.8363	1523.0330	1367.3103	1135.9395	795.1500	520.1207	354.7292	(83)
Total gains	1533.9341	1772.5395	2016.5059	2296.3029	2422.3647	2490.0633	2363.9362	2212.2892	2015.9389	1737.2027	1536.1799	1435.2072	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	23.0550	23.1321	23.1321	23.2416	23.2416	23.3758	23.3435	23.4071	23.3758	23.3104	23.3104	23.2060	
alpha	2.5370	2.5421	2.5421	2.5494	2.5494	2.5584	2.5562	2.5605	2.5584	2.5540	2.5540	2.5471	
util living area	0.9733	0.9608	0.9338	0.8757	0.7715	0.5861	0.4249	0.4595	0.7231	0.8984	0.9584	0.9769	(86)
Living	18.7614	18.9653	19.3816	19.9056	20.3913	20.7281	20.8359	20.8258	20.5837	19.9866	19.2948	18.7287	
Non living	17.3894	17.6501	18.1775	18.8347	19.4211	19.7913	19.8824	19.8790	19.6519	18.9469	18.0764	17.3517	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.8548	18.9653	19.3816	19.9056	20.3913	20.7281	20.8359	20.8258	20.5837	19.9866	19.2948	19.0464	(87)
Th 2	20.0440	20.0469	20.0469	20.0510	20.0510	20.0559	20.0547	20.0571	20.0559	20.0535	20.0535	20.0497	(88)
util rest of house	0.9694	0.9551	0.9236	0.8550	0.7286	0.5046	0.3088	0.3412	0.6571	0.8769	0.9512	0.9735	(89)
MIT 2	18.9857	17.6501	18.1775	18.8347	19.4211	19.7913	19.8824	19.8790	19.6519	18.9469	18.0764	17.8379	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	19.1162	17.8476	18.3583	18.9955	19.5668	19.9320	20.0256	20.0212	19.7918	19.1030	18.2593	18.0193	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1162	17.8476	18.3583	18.9955	19.5668	19.9320	20.0256	20.0212	19.7918	19.1030	18.2593	18.0193	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9648	0.9370	0.8998	0.8263	0.7030	0.4927	0.3050	0.3364	0.6355	0.8488	0.9322	0.9636	(94)
Useful gains	1479.9839	1660.8129	1814.3619	1897.5483	1702.8863	1226.9462	720.9580	744.1413	1281.0931	1474.6005	1432.0651	1382.9723	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	4997.2494	4352.1214	3893.9765	3216.8123	2322.4850	1382.6403	748.4633	780.0178	1614.6549	2645.7455	3617.7016	4576.2099	(97)
Space heating kWh	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98a)
Space heating requirement - total per year (kWh/year)												12204.2486	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12204.2486	
Space heating per m2											(98c) / (4) =	35.8527	(99)

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 %)	302.5548	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98)
Space heating efficiency (main heating system 1)	302.5548	302.5548	302.5548	302.5548	302.5548	0.0000	0.0000	0.0000	0.0000	302.5548	302.5548	302.5548	(210)
Space heating fuel (main heating system)	864.9163	597.7626	511.3895	313.9498	152.3630	0.0000	0.0000	0.0000	0.0000	287.9914	520.1234	785.2359	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
Efficiency of water heater												168.0672	(216)
(217)m	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	(217)
Fuel for water heating, kWh/month	212.4026	187.8864	199.3420	174.2125	168.2511	150.8901	148.2107	154.3751	156.4138	175.3097	187.5636	209.9088	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	55.0964	44.2004	39.7975	29.1574	22.5220	18.4007	20.5453	26.7056	34.6879	45.5124	51.4062	56.6277	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.8851	-28.5371	-45.5494	-58.5764	-66.2267	-65.1154	-63.6582	-58.3191	-47.8699	-36.6329	-23.3473	-16.6004	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.5736	-5.2183	-11.2989	-20.0054	-28.4122	-34.4879	-33.5535	-28.4915	-19.8861	-9.4603	-3.9518	-2.0068	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4033.7319	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	168.0672	
Water heating fuel used	2124.7662	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	444.6593	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-729.6639	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5873.4935	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3226.9855	26.7600	961.6417	(240)
Space heating - main system 1 (low-rate cost)	806.7464	0.1460	117.7850	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1487.3363	29.8000	443.2262	(245)
Low-rate cost	637.4299	14.6000	93.0648	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	444.6593	28.2800	125.7496	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	28.2800	-149.9738	
PV Unit electricity exported	-199.3462	5.8100	-11.5820	
Total			-161.5558	(252)
Total energy cost			1583.9114	(255)

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 (high-rate cost)	3226.9855	0.1627	525.1317	(261)
Space heating - main system 1 (low-rate cost)	806.7464	0.1366	110.2093	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1487.3363	0.1480	220.0577	(264)
Water heating - low rate cost	637.4299	0.1242	79.1526	(264)
Space and water heating			934.5514	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	444.6593	0.1490	66.2630	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	0.1370	-72.6288	
PV Unit electricity exported	-199.3462	0.1211	-24.1477	
Total			-96.7766	(269)
Total CO2, kg/year			904.0378	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	3226.9855	1.2854	5184.8114	(275)
Space heating - main system 1 (low-rate cost)	806.7464	1.4943	1205.5238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1487.3363	1.5531	2309.9092	(278)
Water heating - low rate cost	637.4299	1.4444	920.6965	(278)
Space and water heating			9620.9410	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	444.6593	1.5547	691.3316	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	1.5107	-801.1321	
PV Unit electricity exported	-199.3462	0.4443	-88.5606	
Total			-889.6927	(283)
Total Primary energy kWh/year			9422.5799	(286)

SAP 10 EPC IMPROVEMENTS

P4 Oakley

Current energy efficiency rating:	B 83
Current environmental impact rating:	A 97

N Solar water heating	SAP increase too small
U Solar photovoltaic panels	Already installed
V2 Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.8	-£ 94	-47 kg (5.2%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 83
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1745	£1745	£0
Space heating	£1083	£1083	£0
Water heating	£536	£536	£0
Lighting	£126	£126	£0
Generated (PV)	-£162	-£162	£0
Total cost of fuels	£1583	£1583	£0
Total cost of uses	£1583	£1583	£0
Delivered energy	17 kWh/m²	17 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	3 kg/m²	3 kg/m²	0 kg/m²
Primary energy	28 kWh/m²	28 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000 (1b)	x	2.5300 (2b)	=	430.6060	(1b) - (3b)
First floor	170.2000 (1c)	x	2.9800 (2c)	=	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	937.8020	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0960 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.2960 (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) =	0.2738 (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	0.3491	0.3422	0.3354	0.3011	0.2943	0.2601	0.2601	0.2532	0.2738	0.2943	0.3080	0.3217	(22b)
Effective ac	0.5609	0.5586	0.5562	0.5453	0.5433	0.5338	0.5338	0.5321	0.5375	0.5433	0.5474	0.5517	(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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29591.5340 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		86.9317 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019

E16 Corner (normal)	33.0600	0.0570	1.8844	
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620	
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184	
E3 Sill	29.0500	0.0450	1.3073	
E4 Jamb	90.8000	0.0510	4.6308	
E5 Ground floor (normal)	56.8900	0.0640	3.6410	
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000	
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664	
R6 Flat ceiling	16.0600	0.1200	1.9272	
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260	
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.5773 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 189.0096 (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	173.5908	172.8587	172.1411	168.7705	168.1399	165.2042	165.2042	164.6606	166.3350	168.1399	169.4156	170.7494	(38)
Heat transfer coeff	362.6005	361.8684	361.1507	357.7802	357.1495	354.2139	354.2139	353.6702	355.3447	357.1495	358.4253	359.7590	(39)

Average = Sum(39)m / 12 = 357.7771

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0652	1.0631	1.0610	1.0511	1.0492	1.0406	1.0406	1.0390	1.0439	1.0492	1.0530	1.0569	(40)
HLP (average)												1.0510	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.1845 (42)

Hot water usage for mixer showers

106.7174	105.1137	102.7767	98.3053	95.0055	91.3256	89.2340	91.5533	94.0956	98.0467	102.6142	106.3085	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day) 172.3962 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	187.4586	183.6394	178.8840	171.4029	165.4179	158.9476	156.2766	161.0095	166.0273	172.8439	180.4476	186.9365	(44)
Energy conte	296.8886	261.5001	274.9380	234.6420	222.6844	195.4447	189.0031	199.3634	204.7282	234.5476	257.0807	292.6973	(45)
Energy content (annual)										Total = Sum(45)m =		2863.5180	
Distribution loss (46)m = 0.15 x (45)m	44.5333	39.2250	41.2407	35.1963	33.4027	29.3167	28.3505	29.9045	30.7092	35.1821	38.5621	43.9046	(46)

Water storage loss:

Store volume	400.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.2000	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1880	(55)

Total storage loss

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)

If cylinder contains dedicated solar storage

36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
									Total per year (kWh/year) = Sum(64)m =			3571.0340	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)

Heat gains from water heating, kWh/month

146.7878	130.3689	139.4892	124.5401	122.1149	111.5069	110.9158	114.3607	114.5937	126.0594	132.0009	145.3942	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.9461	55.9082	45.4676	34.4219	25.7308	21.7230	23.4725	30.5104	40.9510	51.9967	60.6878	64.6956	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(70)
Losses e.g. evaporation (negative values) (Table 5)	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)	197.2954	194.0014	187.4855	172.9723	164.1329	154.8708	149.0804	153.7106	159.1580	169.4347	183.3346	195.4223	(72)
Total internal gains	1112.8845	1110.1449	1074.0559	1007.7661	938.8201	877.2270	840.9032	844.9789	879.9995	942.0527	1016.0593	1080.4779	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	10.6334	0.7200	0.7000	0.7700	68.2623	(74)
East	5.9900	19.6403	0.7200	0.7000	0.7700	41.0902	(76)
South	14.8400	46.7521	0.7200	0.7000	0.7700	242.3251	(78)
West	4.2500	19.6403	0.7200	0.7000	0.7700	29.1541	(80)

Solar gains	380.8318	664.7317	953.5075	1257.4713	1479.5270	1500.5251	1433.4428	1262.6404	1057.8091	746.3962	459.0347	324.0636	(83)
Total gains	1493.7162	1774.8766	2027.5633	2265.2374	2418.3472	2377.7521	2274.3460	2107.6193	1937.8086	1688.4489	1475.0939	1404.5415	(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	22.6692	22.7151	22.7602	22.9746	23.0152	23.2060	23.2060	23.2416	23.1321	23.0152	22.9333	22.8483	
alpha	2.5113	2.5143	2.5173	2.5316	2.5343	2.5471	2.5471	2.5494	2.5421	2.5343	2.5289	2.5232	
util living area	0.9774	0.9644	0.9417	0.8970	0.8196	0.7007	0.5737	0.6205	0.7961	0.9212	0.9671	0.9806	(86)
Living	18.5636	18.8043	19.1998	19.7158	20.2004	20.5744	20.7509	20.7176	20.4179	19.7851	19.0796	18.5206	
Non living	17.1273	17.4347	17.9377	18.5917	19.1881	19.6288	19.8103	19.7834	19.4600	18.6885	17.7936	17.0770	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.7536	18.8043	19.1998	19.7158	20.2004	20.5744	20.7509	20.7176	20.4179	19.7851	19.0796	18.8674	(87)
Th 2	20.0293	20.0311	20.0328	20.0410	20.0425	20.0497	20.0497	20.0510	20.0469	20.0425	20.0394	20.0362	(88)
util rest of house	0.9742	0.9594	0.9331	0.8805	0.7873	0.6399	0.4798	0.5301	0.7480	0.9053	0.9617	0.9778	(89)
MIT 2	18.8724	17.4347	17.9377	18.5917	19.1881	19.6288	19.8103	19.7834	19.4600	18.6885	17.7936	17.6102	(90)
Living area fraction										fLA = Living area / (4) =		0.1501	(91)
MIT	19.0047	17.6403	18.1272	18.7605	19.3401	19.7708	19.9515	19.9237	19.6038	18.8531	17.9867	17.7990	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0047	17.6403	18.1272	18.7605	19.3401	19.7708	19.9515	19.9237	19.6038	18.8531	17.9867	17.7990	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9702	0.9422	0.9103	0.8526	0.7589	0.6195	0.4691	0.5164	0.7210	0.8790	0.9451	0.9690	(94)
Useful gains	1449.1766	1672.2776	1845.7828	1931.2659	1835.2438	1473.1103	1066.8284	1088.3418	1397.1314	1484.2224	1394.0994	1361.0496	(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	5331.9401	4610.3220	4199.1658	3527.8936	2728.6560	1831.5735	1187.1644	1246.2179	1955.7568	2947.6034	3902.0677	4892.3625	(97)
Space heating kWh	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98a)
Space heating requirement - total per year (kWh/year)												13950.1189	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13950.1189	
Space heating per m2											(98c) / (4) =	40.9815	(99)

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 %)												302.6854	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2888.7761	1974.3658	1750.9170	1149.5719	664.6987	0.0000	0.0000	0.0000	0.0000	1088.7555	1805.7371	2627.2968	(98)
Space heating efficiency (main heating system 1)	302.6854	302.6854	302.6854	302.6854	302.6854	0.0000	0.0000	0.0000	0.0000	302.6854	302.6854	302.6854	(210)
Space heating fuel (main heating system)	954.3823	652.2831	578.4609	379.7910	219.6005	0.0000	0.0000	0.0000	0.0000	359.6987	596.5722	867.9958	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
Efficiency of water heater												168.0789	(216)
(217)m	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	168.0789	(217)
Fuel for water heating, kWh/month	212.3878	187.8733	199.3281	174.2004	168.2393	150.8796	148.2003	154.3643	156.4029	175.2975	187.5505	209.8942	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	55.0964	44.2004	39.7975	29.1574	22.5220	18.4007	20.5453	26.7056	34.6879	45.5124	51.4062	56.6277	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.9112	-28.3748	-45.8483	-57.6019	-66.8416	-61.5300	-60.6750	-54.5753	-44.8316	-34.5090	-20.6252	-15.0850	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.1234	-5.0572	-11.0902	-18.7069	-27.4315	-31.1555	-30.7856	-25.3343	-17.7537	-8.2293	-3.1387	-1.6806	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4608.7844	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												168.0789	

Water heating fuel used	2124.6181	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	444.6593	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-690.8958	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6487.1661	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3687.0275	17.5600	722.6574	(240)
Space heating - main system 1 (low-rate cost)	921.7569	0.0940	86.6451	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1487.2327	19.6000	291.4976	(245)
Low-rate cost	637.3854	9.4000	59.9142	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	444.6593	18.5800	82.6177	(250)
Additional standing charges			7.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.4089	18.5800	-94.4624	
PV Unit electricity exported	-182.4868	5.5900	-10.2010	
Total			-104.6634	(252)
Total energy cost			1145.6687	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	1.0702	(257)
SAP value	82.6527	
SAP rating (Section 12)	83	(258)
SAP band	B	

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 (high-rate cost)	3687.0275	0.1621	597.8490	(261)
Space heating - main system 1 (low-rate cost)	921.7569	0.1361	125.4735	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1487.2327	0.1480	220.0424	(264)
Water heating - low rate cost	637.3854	0.1242	79.1471	(264)
Space and water heating			1022.5120	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	444.6593	0.1490	66.2630	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-508.4089	0.1371	-69.6783	
PV Unit electricity exported	-182.4868	0.1214	-22.1596	
Total			-91.8379	(269)
Total CO2, kg/year			996.9371	(272)
CO2 emissions per m2			2.9300	(273)
EI value			96.5337	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	170.2000	(1b)	x 2.5300	(2b) =	430.6060	(1b) - (3b)
First floor	170.2000	(1c)	x 2.9800	(2c) =	507.1960	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	340.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		937.8020	(5)

2. Ventilation rate

m3 per hour

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	1 * 20 =	20.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	90.0000 / (5) =	0.0960	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2960	(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) =	0.2738	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2875	0.2738	0.2738	0.2532	0.2532	0.2259	0.2327	0.2190	0.2259	0.2395	0.2395	0.2601	(22b)
Effective ac	0.5413	0.5375	0.5375	0.5321	0.5321	0.5255	0.5271	0.5240	0.5255	0.5287	0.5287	0.5338	(25)

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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	
Front Door			7.3100	1.2000	8.7720			(26a)
Other Ext Door			22.9100	1.2000	27.4920			(26a)
Windows (Uw = 1.20)			43.4600	1.1450	49.7634			(27)
Heat Loss Floor 1			170.2000	0.1100	18.7220	0.0000	0.0000	(28a)
External Wall 1	313.4639	73.6800	239.7839	0.1900	45.5589	60.0000	14387.0340	(29a)
External Roof 3	170.2000		170.2000	0.0900	15.3180	9.0000	1531.8000	(30)
External Roof 2	12.0400		12.0400	0.1500	1.8060	9.0000	108.3600	(30)
Total net area of external elements Aum(A, m2)			665.9039					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		167.4323			(33)
Internal Wall 1			76.7600			100.0000	7676.0000	(32c)
Internal Wall 2			143.6600			9.0000	1292.9400	(32c)
Internal Floor 1			170.2000			18.0000	3063.6000	(32d)
Internal Ceiling 1			170.2000			9.0000	1531.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29591.5340 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		86.9317 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E10 Eaves (insulation at ceiling level)	40.8900	0.1370	5.6019
E16 Corner (normal)	33.0600	0.0570	1.8844
E17 Corner (inverted - internal area greater than external area)	11.0200	-0.0510	-0.5620
E1 Steel lintel with perforated steel base plate	42.0500	0.0480	2.0184
E3 Sill	29.0500	0.0450	1.3073
E4 Jamb	90.8000	0.0510	4.6308
E5 Ground floor (normal)	56.8900	0.0640	3.6410
E6 Intermediate floor within a dwelling	56.8900	0.0000	0.0000
E11 Eaves (insulation at rafter level)	16.6600	0.0400	0.6664
R6 Flat ceiling	16.0600	0.1200	1.9272
R7 Flat ceiling (inverted)	1.0500	0.1200	0.1260
R9 Roof to wall (flat ceiling)	1.0500	0.3200	0.3360

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		21.5773 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	189.0096 (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	167.5238	166.3350	166.3350	164.6606	164.6606	162.6310	163.1167	162.1598	162.6310	163.6168	163.6168	165.2042	(38)
Heat transfer coeff	356.5334	355.3447	355.3447	353.6702	353.6702	351.6406	352.1263	351.1695	351.6406	352.6264	352.6264	354.2139	(39)
Average = Sum(39)m / 12 =												353.3839	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0474	1.0439	1.0439	1.0390	1.0390	1.0330	1.0344	1.0316	1.0330	1.0359	1.0359	1.0406	(40)
HLP (average)												1.0381	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.1845 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
106.7174	105.1137	102.7767	98.3053	95.0055	91.3256	89.2340	91.5533	94.0956	98.0467	102.6142	106.3085	(42a)

Hot water usage for baths

33.4992	33.0017	32.3011	31.0093	30.0421	28.9695	28.3902	29.0859	29.8434	30.9910	32.3094	33.3860	(42b)

Hot water usage for other uses

47.2420	45.5241	43.8062	42.0883	40.3704	38.6525	38.6525	40.3704	42.0883	43.8062	45.5241	47.2420	(42c)

Average daily hot water use (litres/day)		172.3962 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	187.4586	183.6394	178.8840	171.4029	165.4179	158.9476	156.2766	161.0095	166.0273	172.8439	180.4476	186.9365	(44)
Energy conte	296.8886	261.5001	274.9380	234.6420	222.6844	195.4447	189.0031	199.3634	204.7282	234.5476	257.0807	292.6973	(45)
Energy content (annual)										Total = Sum(45)m =		2863.5180	
Distribution loss (46)m = 0.15 x (45)m	44.5333	39.2250	41.2407	35.1963	33.4027	29.3167	28.3505	29.9045	30.7092	35.1821	38.5621	43.9046	(46)

Water storage loss:		
Store volume		400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		2.2000 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.1880 (55)
Total storage loss		

	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(56)
If cylinder contains dedicated solar storage													
	36.8280	33.2640	36.8280	35.6400	36.8280	35.6400	36.8280	36.8280	35.6400	36.8280	35.6400	36.8280	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
											Total per year (kWh/year) = Sum(64)m =	3571.0340	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	146.7878	130.3689	139.4892	124.5401	122.1149	111.5069	110.9158	114.3607	114.5937	126.0594	132.0009	145.3942	(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	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	191.0670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.9461	55.9082	45.4676	34.4219	25.7308	21.7230	23.4725	30.5104	40.9510	51.9967	60.6878	64.6956	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	731.6628	739.2552	720.1226	679.3918	627.9763	579.6531	547.3702	539.7778	558.9103	599.6412	651.0566	699.3799	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	57.2912	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	-127.3780	(71)
Water heating gains (Table 5)													
	197.2954	194.0014	187.4855	172.9723	164.1329	154.8708	149.0804	153.7106	159.1580	169.4347	183.3346	195.4223	(72)
Total internal gains													
	1112.8845	1110.1449	1074.0559	1007.7661	938.8201	877.2270	840.9032	844.9789	879.9995	942.0527	1016.0593	1080.4779	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	18.3800	11.9814	0.7200	0.7000	0.7700	76.9163	(74)
East	5.9900	22.3313	0.7200	0.7000	0.7700	46.7202	(76)
South	14.8400	50.9848	0.7200	0.7000	0.7700	264.2644	(78)
West	4.2500	22.3313	0.7200	0.7000	0.7700	33.1487	(80)

Solar gains	421.0496	662.3946	942.4501	1288.5368	1483.5446	1612.8363	1523.0330	1367.3103	1135.9395	795.1500	520.1207	354.7292	(83)
Total gains	1533.9341	1772.5395	2016.5059	2296.3029	2422.3647	2490.0633	2363.9362	2212.2892	2015.9389	1737.2027	1536.1799	1435.2072	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.0550	23.1321	23.1321	23.2416	23.2416	23.3758	23.3435	23.4071	23.3758	23.3104	23.3104	23.2060	
alpha	2.5370	2.5421	2.5421	2.5494	2.5494	2.5584	2.5562	2.5605	2.5584	2.5540	2.5540	2.5471	
util living area													
	0.9733	0.9608	0.9338	0.8757	0.7715	0.5861	0.4249	0.4595	0.7231	0.8984	0.9584	0.9769	(86)
Living	18.7614	18.9653	19.3816	19.9056	20.3913	20.7281	20.8359	20.8258	20.5837	19.9866	19.2948	18.7287	
Non living	17.3894	17.6501	18.1775	18.8347	19.4211	19.7913	19.8824	19.8790	19.6519	18.9469	18.0764	17.3517	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	19.8548	18.9653	19.3816	19.9056	20.3913	20.7281	20.8359	20.8258	20.5837	19.9866	19.2948	19.0464	(87)
Th 2	20.0440	20.0469	20.0469	20.0510	20.0510	20.0559	20.0547	20.0571	20.0559	20.0535	20.0535	20.0497	(88)
util rest of house													
	0.9694	0.9551	0.9236	0.8550	0.7286	0.5046	0.3088	0.3412	0.6571	0.8769	0.9512	0.9735	(89)
MIT 2	18.9857	17.6501	18.1775	18.8347	19.4211	19.7913	19.8824	19.8790	19.6519	18.9469	18.0764	17.8379	(90)
Living area fraction											fLA = Living area / (4) =	0.1501	(91)
MIT	19.1162	17.8476	18.3583	18.9955	19.5668	19.9320	20.0256	20.0212	19.7918	19.1030	18.2593	18.0193	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1162	17.8476	18.3583	18.9955	19.5668	19.9320	20.0256	20.0212	19.7918	19.1030	18.2593	18.0193	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9648	0.9370	0.8998	0.8263	0.7030	0.4927	0.3050	0.3364	0.6355	0.8488	0.9322	0.9636	(94)
Useful gains	1479.9839	1660.8129	1814.3619	1897.5483	1702.8863	1226.9462	720.9580	744.1413	1281.0931	1474.6005	1432.0651	1382.9723	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4997.2494	4352.1214	3893.9765	3216.8123	2322.4850	1382.6403	748.4633	780.0178	1614.6549	2645.7455	3617.7016	4576.2099	(97)
Space heating kWh													
	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98a)
Space heating requirement - total per year (kWh/year)												12204.2486	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12204.2486	
Space heating per m2											(98c) / (4) =	35.8527	(99)

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 %)												302.5548	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2616.8455	1808.5593	1547.2333	949.8701	460.9815	0.0000	0.0000	0.0000	0.0000	871.3319	1573.6583	2375.7688	(98)
Space heating efficiency (main heating system 1)													
	302.5548	302.5548	302.5548	302.5548	302.5548	0.0000	0.0000	0.0000	0.0000	302.5548	302.5548	302.5548	(210)
Space heating fuel (main heating system)													
	864.9163	597.7626	511.3895	313.9498	152.3630	0.0000	0.0000	0.0000	0.0000	287.9914	520.1234	785.2359	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	356.9790	315.7753	335.0284	292.7940	282.7748	253.5967	249.0935	259.4538	262.8802	294.6380	315.2327	352.7877	(64)
Efficiency of water heater												168.0672	(216)
(217)m	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	168.0672	(217)
Fuel for water heating, kWh/month													
	212.4026	187.8864	199.3420	174.2125	168.2511	150.8901	148.2107	154.3751	156.4138	175.3097	187.5636	209.9088	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	55.0964	44.2004	39.7975	29.1574	22.5220	18.4007	20.5453	26.7056	34.6879	45.5124	51.4062	56.6277	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.8851	-28.5371	-45.5494	-58.5764	-66.2267	-65.1154	-63.6582	-58.3191	-47.8699	-36.6329	-23.3473	-16.6004	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.5736	-5.2183	-11.2989	-20.0054	-28.4122	-34.4879	-33.5535	-28.4915	-19.8861	-9.4603	-3.9518	-2.0068	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4033.7319	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												168.0672	
Water heating fuel used												2124.7662	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												444.6593	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-729.6639	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												5873.4935	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	3226.9855	26.7600	961.6417	(240)
Space heating - main system 1 (low-rate cost)	806.7464	0.1460	117.7850	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.7000	(243)
Low-rate fraction			0.3000	(244)
High-rate cost	1487.3363	29.8000	443.2262	(245)
Low-rate cost	637.4299	14.6000	93.0648	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	0.0000	0.0000	0.0000	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	444.6593	28.2800	125.7496	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	28.2800	-149.9738	
PV Unit electricity exported	-199.3462	5.8100	-11.5820	
Total			-161.5558	(252)
Total energy cost			1583.9114	(255)

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 (high-rate cost)	3226.9855	0.1627	525.1317	(261)
Space heating - main system 1 (low-rate cost)	806.7464	0.1366	110.2093	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	1487.3363	0.1480	220.0577	(264)

Water heating - low rate cost	637.4299	0.1242	79.1526	(264)
Space and water heating			934.5514	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	444.6593	0.1490	66.2630	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	0.1370	-72.6288	
PV Unit electricity exported	-199.3462	0.1211	-24.1477	
Total			-96.7766	(269)
Total CO2, kg/year			904.0378	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	3226.9855	1.2854	5184.8114	(275)
Space heating - main system 1 (low-rate cost)	806.7464	1.4943	1205.5238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	1487.3363	1.5531	2309.9092	(278)
Water heating - low rate cost	637.4299	1.4444	920.6965	(278)
Space and water heating			9620.9410	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	444.6593	1.5547	691.3316	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-530.3177	1.5107	-801.1321	
PV Unit electricity exported	-199.3462	0.4443	-88.5606	
Total			-889.6927	(283)
Total Primary energy kWh/year			9422.5799	(286)

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