ENERGY STATEMENT

—

OS PARCEL 4300 NORTH OF SHORTLANDS AND SOUTH OF HIGH ROCK
HOOK NORTON ROAD
SIBFORD FERRIS
OXFORDSHIRE
OX15 5QW

—

PREPARED FOR:
GADE

—

03 AUGUST 2021
REVISION 2

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ISSUE SCHEDULE

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REVISION	DATE	BY	STATUS	DETAILS
0	30.07.2021	MW	SUBMISSION	First draft issued for review and comment.
1	02.08.2021	MW	SUBMISSION	Updated to client's comments.
2	03.08.2021	MW	SUBMISSION	Dwelling mix corrected.

EXECUTIVE SUMMARY

This Energy Statement has been prepared by MCA Consulting Engineers Ltd in support of a discharging planning condition 12 for a residential development of 25 newly constructed dwellings at OS Parcel 4300 North of Shortlands and South of High Rock, Hook Norton Road, Sibford Ferris, Oxfordshire OX15 5QW.

The design has been developed to address the energy performance policy requirements of The Cherwell Local Plan 2011 – 2031, and the proposed introduction of the Future Homes Standard. An on-site target CO2 reduction has therefore been set at 31% relative to the Building Regulations 2013, through the application of the energy hierarchy.

A base case has been developed, against which potential savings can be assessed. This base case is the notional building developed for the Building Regulations (2013) assessment and is quantified in terms of CO2 emissions as the Target Emission Rate (TER) for the dwellings.

This proposed development features improved insulation and air tightness standards, when compared against the compliance requirements of Approved Document L1A 2013 of the Building Regulations. In addition, this proposed development will incorporate a mechanical and electrical specification that surpasses the requirements of the Domestic Building Services Compliance Guide. These combined energy efficiency measures lead to a reduction in CO2 emissions equivalent to 3.7% of the baseline.

Having minimised energy consumption in the first instance, the potential for remaining energy demands to be met via a decentralised energy source has been considered. It is evident this proposed development is neither within the coverage of an existing district heating network, nor is there an expectation that a district heating network will be developed at this site in the near future.

Due to its size, this development is not suitable for combined heat and power.

An assessment has been carried out to determine the potential for renewable energy systems to reduce CO2 emissions further. There is potential for air source heat pumps to be installed in each dwelling of the development in order to meet the expectations of the planning policy. This development will seek to achieve a reduction in CO2 emissions equivalent to 36.1% of the baseline through the installation of air source heat pump systems.

The total reduction in emissions resulting from energy efficiency measures and the installation of renewable technology is 39.8% compared to the regulated emissions from a building designed to just meet Building Regulations (2013) Part L1A. This surpasses the on-site target reduction of 31%.

CONTENTS

1 INTRODUCTION

Energy use in buildings is a significant contributor to global CO_2 emissions and global warming. Designing energy efficient buildings and incorporating low and zero carbon energy generation is a vital part of ensuring this development incorporates sustainability as a core part of its design.

The purpose of the report is to assist evaluating parties to understand the energy consumption and performance of the proposed development and consider its performance against the "lean, clean, green" performance standard.

.01 OVERVIEW OF THE PROPOSED DEVELOPMENT

The proposed development consists of 25 newly constructed dwellings. By virtue of there being more than 10 dwellings, the proposed development is deemed to be a major development.

The site is situated on the existing farmland.

The proposed development consists of 25no. residential dwellings and access onto Hook Norton Road. The dwelling mix includes 2no flat-over-garage apartments, 14no semi-detached/terraced houses and 9no detached houses. The proposed buildings have been designed with consideration to energy efficiency, and consideration has been given to local generation of energy from renewable and low carbon sources.

Figure 1 - Site Plan

2 POLICIES AND DRIVERS

.01 NATIONAL AND INTERNATIONAL POLICY

The Climate Change Act (2008) sets a legally binding target for reducing UK carbon dioxide (CO2) emissions to zero by 2050. It also provides for a Committee on Climate Change, which sets out carbon budgets binding on the Government for 5-year periods.

The National Planning Policy Framework (NPPF) 2019, reflects the requirements of the Climate Change Act 2008 in paragraphs 148 and 149 as follows:

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings;"

"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures (in line with the objectives and provisions of the Climate Change Act 2008). Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."

.02 LOCAL POLICY: CHERWELL LOCAL PLAN 2011 – 2031

.01 POLICY ESD 3: SUSTAINABLE CONSTRUCTION

"All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance and allowable solutions in line with Government policy.

Cherwell District is in an area of water stress and as such the Council will seek a higher level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 litres/person/day.

All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.

The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability.

All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demands and energy loss
- Maximising passive solar lighting and natural ventilation
- Maximising resource efficiency
- Incorporating the use of recycled and energy efficient materials
- Incorporating the use of locally sourced building materials
- Reducing waste and pollution and making adequate provision for the recycling of waste
- Making use of sustainable drainage methods
- Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and
- Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment.

Should the promoters of development consider that individual proposals would be unviable with the above requirements, 'open-book' financial analysis of proposed developments will be expected so that an independent economic viability assessment can be undertaken. Where it is agreed that an economic viability assessment is required, the cost shall be met by the promoter."

.02 POLICY ESD 4: DECENTRALISED ENERGY SYSTEMS

"The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non-domestic developments above 1000m2 floorspace.

The feasibility assessment should be informed by the renewable energy map at Appendix 5 'Maps' and the national mapping of heat demand densities undertaken by the Department for Energy and Climate Change (DECC) (see Appendix 3: Evidence Base).

Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit."

.03 POLICY ESD 5: RENEWABLE ENERGY

"The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

Planning applications involving renewable energy development will be encouraged provided that there is no unacceptable adverse impact, including cumulative impact, on the following issues, which are considered to be of particular local significance in Cherwell:

- Landscape and biodiversity including designations, protected habitats and species, and Conservation Target Areas
- Visual impacts on local landscapes
- The historic environment including designated and non designated assets and their settings
- The Green Belt, particularly visual impacts on openness
- Aviation activities
- Highways and access issues, and
- Residential amenity.

A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non-domestic developments above 1000m2 floorspace.

Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit. This may include consideration of 'allowable solutions' as Government Policy evolves."

.03 FUTURE HOMES STANDARD

The UK Government has set out a roadmap towards its new Future Homes Standard, which will come into effect in 2025, and will require all new homes to reduce CO2 emissions by at least 75% over current standards, as well as banning the use of fossil fuel-based heating.

As part of this roadmap there will be an uplift to the current Approved Documents L, which will come into effect in 2022[1], and will require all new homes to cut CO2 emissions by 31% over current standards.

.04 PROJECT POLICY

To ensure this scheme is future-proofed to be compliant with the new Approved Documents L when these come into force next year, the target CO2 reduction has been set at 35% relative to the Building Regulations 2013, through the application of the energy hierarchy.

[1] Approved Document L, Volume 1: Dwellings (Conservation of fuel and power) is expected to come into force from June 2022, with transitional arrangements applying for 1 year.

3 ENERGY HIERARCHY

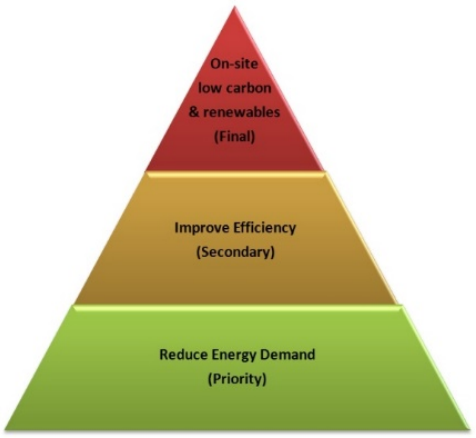
In line with best practice the proposed energy strategy for this development will follow the principles of the energy hierarchy.

The energy hierarchy has three priorities, seeking to reduce energy use before meeting remaining demand by the cleanest means possible:

.01 Be lean – use less energy: Optimise the building fabric, glazing, and structure to minimise energy consumption in the first instance by using low U-values and good air tightness and ensure that active systems run as energy efficiently as possible.

.02 Be clean – supply energy efficiently: Further reduce carbon emissions through the use of decentralised energy where feasible, such as combined heat and power (CHP).

.03 Be green – use renewable energy: When the above design elements have been reasonably exhausted, supply energy through renewable sources where practical.



4 ENERGY EFFICIENT DESIGN MEASURES *("BE LEAN")*

Enhancing the thermal performance of the building envelope helps to future-proof the structure and also yields the greatest CO_2 savings. Adding renewable technology will then yield maximum carbon reductions with lower long-term costs for the developer.

The proposed development will achieve compliance with Approved Document L1A of the Building Regulations (2013) without reliance on the contribution of renewable technologies.

The following energy-efficient design measures are proposed:

	Proposed development	**L1A 2013 requirements**
External wall U–value (W/m²K)	0.15	0.30
Sheltered wall U–value (W/m²K)	0.25	0.3
Roof U–value (W/m²K)	0.11	0.20
Ground floor U–value (W/m²K)	0.11	0.25
Exposed floor(W/m²K)	0.11	0.25
Window U–value (W/m²K)	0.8	2.00
Door U-value (W/m²K)	1.00	2.00
Air permeability	5 m3/h.m2	10 $m^3/h.m^2$
Thermal bridging	Accredited construction details	Y=0.15

Having reduced energy demand through improvements to the fabric, this development shall seek to reduce energy consumption further through the specification of mechanical and electrical systems with efficiencies that surpass the requirements of the Domestic Building Services Compliance Guide:

	Proposed development	L1A 2013 requirements
Low energy lighting	100%	75%
Air Source heat pump (for example Mitsubishi Ecodan)	COP > 3.1	COP > 2.5
Heating controls	Time and temperature zone controls	Programmer, thermostat and TRVs.

5 ENERGY EFFICIENT SYSTEMS *("BE CLEAN")*

.01 COMBINED HEAT AND POWER

Combined heat and power (CHP) systems use relatively cheap and clean fuels (such as natural gas) to generate heat and electricity on site. A typical CHP system uses combustion of natural gas to drive a turbine that produces electricity. The heat generated is captured and used to produce hot water.

As losses are minimised the carbon footprint of the energy generated is very low. However, this is dependent on there being sufficient year-round local heat demand to fully utilise the heat generated by the CHP plant. An example would be developments of at least 500 dwellings, universities, or hospitals.

Due to its size, this development is not suitable for combined heat and power.

.02 DISTRICT HEATING NETWORKS

In a district heating network heat is supplied from one or more central energy centres to multiple buildings within the network. Supply to multiple buildings guarantees high year-round local heat demand which in turn allows the use of low carbon technologies within the energy centre, such as combined heat and power systems. Large plant and aggregated demand allow systems within the energy centre to run more efficiently.

Hot water is distributed within the network via highly insulated pipes. To connect to the network individual boilers are replaced with separately metered heat exchangers.

Due to the fact this proposed development is neither within the coverage of an existing district heating network, nor is it within an area designated as having potential for a future network, district heating can be discounted as a viable option.

6 LOW AND ZERO CARBON ENERGY SOURCES *("BE GREEN")*

.01 PHOTOVOLTAICS

Solar photovoltaics (PV) capture the sun's energy using photovoltaic cells. The cells convert sunlight into electricity, which can be utilised on site or transferred into the National Grid. PV cells are made from layers of semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers. The stronger the sunshine, the more electricity is produced. Groups of cells are mounted together in panels or modules that can be mounted on a roof.

The power of a PV cell is measured in kilowatts peak (kWp). This is the rate at which the cell generates energy at peak performance in full direct sunlight.

Photovoltaics offer high CO_2 savings, are simple to install and suitable for most buildings. The only limiting factor for PV is the availability of suitable roof space.

.02 HEAT PUMPS

Heat pumps collect low temperature heat from renewable sources (such as the air or ground) and concentrate the heat to a usable temperature via a reverse refrigeration cycle. Useable heat is transferred to the dwelling via a heat exchanger and can be used for low temperature central heating and domestic hot water, though an immersion top-up may be required for DHW.

Heat pumps have some impact on the environment as they generally use grid supplied electricity to run the pumps. It is common for heat pumps to have a coefficient of performance of three, meaning that for every 1kWh of electricity used, over 3kWh of heat can be generated. The renewable component of the output is therefore taken as the difference between the output energy and the input energy, in this scenario the heat pump will be deemed to have delivered 2kWh of renewable energy.

Ground source heat pumps require external horizontal ground loops, or as is more likely in built-up environments, vertical loops fed into bore holes. The application of ground source heat pumps is therefore constrained by site ground conditions and available space.

Air source heat pumps have a slightly lower seasonal efficiency than ground source heat pumps, but require less space. Noise and space considerations should be assessed when determining an appropriate site for external condensing units.

Heat pumps are a very good option for sites not connected to the gas network, or as a replacement of existing electric or oil fired heating systems.

.03 SOLAR THERMAL

Solar thermal systems, use free heat from the sun to warm domestic hot water. A conventional boiler or immersion heater can be used to make the water hotter, or to provide hot water when solar energy is unavailable.

Solar thermal systems are most appropriate for buildings with high year-round domestic hot water demand.

Although a typical solar thermal system will be able to meet half the annual domestic hot water demand for a dwelling, many will use electricity to run pumps within the system. This means the resultant CO2 and cost savings in a home with a gas boiler will be relatively low.

.04 WIND TURBINES

Wind turbines use blades to catch the wind. When the wind blows, the blades are forced round, driving a turbine which generates electricity. The stronger the wind, the more electricity produced.

There are two types of domestic-sized wind turbine: Pole mounted and building mounted. Pole mounted turbines are free standing and are erected in a suitably exposed position, and are often about 5kW to 6kW in size. Building mounted turbines are smaller and can be installed on the roof of a home where there is a suitable wind resource. Often these are around 1kW to 2kW in size.

Large scale turbines, in exposed locations offer one of the best financial returns of all renewable energy systems as the payback of the system increases dramatically with the size of the turbine. However small scale systems offer much lower levels of performance and recent studies have questioned the viability and output from such systems, particularly in urban environments.

.05 BIOMASS

Biomass heating systems, burn wood pellets, chips or logs to provide warmth in a single room or to power central heating and hot water boilers. The carbon dioxide emitted when wood is burned is the same amount that was absorbed over the months and years that the plant was growing. The process is sustainable as long as new plants continue to grow in place of those used for fuel. There are some carbon emissions caused by the cultivation, manufacture and transportation of the fuel, but as long as the fuel is sourced locally, these are much lower than the emissions from fossil fuels.

When specifying biomass heating systems is important to consider the potential technical issues surrounding delivery and storage of fuel.

Although the CO_2 savings from biomass are substantial, the high levels of NOx emissions can make biomass systems unsuitable for urban environments.

.06 PROPOSED LOW AND ZERO CARBON ENERGY SOURCES

With carbon emissions within the dwellings already reduced through an enhanced fabric and energy efficient systems, it is proposed that a further reduction will be achieved through the installation of air source heat pumps. For each dwelling the air source heat pump will serve both the central heating and the Domestic Hot Water requirements.

7 RESULTS

.01 CALCULATED CO_2 SAVINGS

Table 1: Carbon Dioxide Emissions for domestic buildings

	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	82.6	48.6
After energy demand reduction	79.6	48.6
After renewable energy	49.7	48.6

Table 2: Regulated carbon dioxide savings for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	**(%)**
Savings from energy demand reduction and renewable energy	3.0	3.7
Savings from renewable energy	29.8	36.1
Cumulative on-site savings	**32.9**	**39.8**

8 CONCLUSION

The chosen strategy for the houses at Sibford Ferris will be in line with the selections from the energy hierarchy strategy detailed in the previous sections of this report.

Be Lean

	Proposed development	L1A 2013 requirements
External wall U–value (W/m^{2}K)	0.15	0.30
Sheltered wall U–value (W/m^{2}K)	0.25	0.3
Roof U–value (W/m^{2}K)	0.11	0.20
Ground floor U–value (W/m^{2}K)	0.11	0.25
Exposed floor(W/m^{2}K)	0.11	0.25
Window U–value (W/m^{2}K)	0.8	2.00
Door U-value (W/m^{2}K)	1.00	2.00
Air permeability	5 m3/h.m2	10 m^3/h.m^2
Thermal bridging	Accredited construction details	Y=0.15

Be Clean

There are currently no suitable options applicable for this site.

Be Green

The houses shall be provided with Air Source Heat Pumps for heating and hot water generation.

This strategy results in the site achieving a 39.8% improvement over Part L.

APPENDIX 1 - SAP WORKSHEETS (Plots 2, 3, 9, 14, 19)

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

Property Reference	4453-2	**Issued on Date**	30/07/2021
Assessment Reference	002	**Prop Type Ref**	
Property	2, Sibford Ferris		

SAP Rating	78 C	**DER**	27.44	**TER**	34.35
Environmental	80 C	**% DER<TER**	20.12		
CO_2 Emissions (t/year)	1.50	**DFEE**	60.20	**TFEE**	71.05
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.26		

Assessor Details	Mr. Harry Davey, energytest, Tel: 01892 315466, hdavey@energy-test.co.uk	**Assessor ID**	R434-0001
Client			

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r17

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 62 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 34.35 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 27.44 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)71.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)60.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	0.83 (max. 2.00)	1.00 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.56: OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 5.04 m², No overhang
Windows facing South: 2.27 m², No overhang
Windows facing West: 5.04 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features
Roof U-value 0.11 W/m²K
Exposed floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Window U-value 0.80 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.7500 (1b)	x	2.4000 (2b)	=	148.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.7500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1350	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3850	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3272	(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	0.4172	0.4090	0.4008	0.3599	0.3518	0.3108	0.3108	0.3027	0.3272	0.3518	0.3681	0.3845	(22b)
Effective ac	0.5870	0.5836	0.5803	0.5648	0.5619	0.5483	0.5483	0.5458	0.5535	0.5619	0.5678	0.5739	(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	
DTC			1.8900	1.0000	1.8900			(26)
Window (Uw = 0.80)			12.3500	0.7752	9.5736			(27)
exposed floor			61.7500	0.1100	6.7925			(28b)
External Wall	71.2800	12.3500	58.9300	0.1500	8.8395			(29a)
corridor	12.0000	1.8900	10.1100	0.1500	1.5165			(29a)
External Roof 1	61.7500		61.7500	0.1100	6.7925			(30)
Total net area of external elements Aum(A, m2)			206.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.4046			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	24.6440	(36)
Total fabric heat loss (33) + (36) =	60.0486	(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	28.7090	28.5438	28.3818	27.6209	27.4785	26.8158	26.8158	26.6931	27.0711	27.4785	27.7665	28.0676	(38)
Heat transfer coeff	88.7577	88.5924	88.4304	87.6695	87.5272	86.8645	86.8645	86.7417	87.1197	87.5272	87.8152	88.1162	(39)
Average = Sum(39)m / 12 =												87.6689	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4374	1.4347	1.4321	1.4197	1.4174	1.4067	1.4067	1.4047	1.4108	1.4174	1.4221	1.4270	(40)
HLP (average)												1.4197	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.0307 (42)
Average daily hot water use (litres/day)	82.4281 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	90.6709	87.3738	84.0767	80.7795	77.4824	74.1853	74.1853	77.4824	80.7795	84.0767	87.3738	90.6709	(44)
Energy conte	134.4623	117.6016	121.3543	105.7997	101.5173	87.6017	81.1759	93.1505	94.2630	109.8544	119.9147	130.2196	(45)
Energy content (annual)										Total = Sum(45)m =		1296.9149	(45)
Distribution loss (46)m = 0.15 x (45)m	20.1694	17.6402	18.2032	15.8699	15.2276	13.1403	12.1764	13.9726	14.1394	16.4782	17.9872	19.5329	(46)

Water storage loss:	
Store volume	250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8000 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	187.8567	165.8288	174.7487	157.4717	154.9117	139.2737	134.5703	146.5449	145.9350	163.2488	171.5867	183.6140	(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													
	187.8567	165.8288	174.7487	157.4717	154.9117	139.2737	134.5703	146.5449	145.9350	163.2488	171.5867	183.6140	(64)
								Total per year (kWh/year) = Sum(64)m =				1925.5909	(64)
Heat gains from water heating, kWh/month													
	87.4242	77.6843	83.0658	76.5160	76.4700	70.4652	69.7065	73.6881	72.6800	79.2421	81.2092	86.0135	(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	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	16.2228	14.4090	11.7181	8.8714	6.6315	5.5986	6.0494	7.8633	10.5541	13.4009	15.6408	16.6737	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	177.3379	179.1781	174.5408	164.6686	152.2067	140.4943	132.6697	130.8295	135.4668	145.3390	157.8009	169.5133	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	(71)
Water heating gains (Table 5)													
	117.5057	115.6016	111.6476	106.2722	102.7823	97.8683	93.6915	99.0431	100.9445	106.5082	112.7906	115.6096	(72)
Total internal gains													
	364.5263	362.6486	351.3665	333.2721	315.0803	297.4210	285.8705	291.1957	300.4252	318.7079	339.6921	355.2564	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0400	19.6403	0.5700	0.7000	0.7700	27.3706	(76)
South	2.2700	46.7521	0.5700	0.7000	0.7700	29.3449	(78)
West	5.0400	19.6403	0.5700	0.7000	0.7700	27.3706	(80)

Solar gains	84.0861	155.1447	237.5734	326.3931	387.3122	392.0621	374.9952	329.7189	269.0579	178.9023	103.0395	70.3732	(83)
Total gains	448.6123	517.7933	588.9399	659.6652	702.3925	689.4831	660.8657	620.9146	569.4832	497.6102	442.7316	425.6296	(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	48.3135	48.4036	48.4923	48.9132	48.9927	49.3665	49.3665	49.4363	49.2218	48.9927	48.8320	48.6652	
alpha	4.2209	4.2269	4.2328	4.2609	4.2662	4.2911	4.2911	4.2958	4.2815	4.2662	4.2555	4.2443	
util living area													
	0.9955	0.9912	0.9796	0.9456	0.8647	0.7151	0.5537	0.6046	0.8319	0.9640	0.9914	0.9964	(86)
Tweekday	18.1738	18.3679	18.6946	19.1118	19.4425	19.6219	19.6598	19.6576	19.5558	19.1310	18.5817	18.1447	
Tweekend	20.2328	20.3184	20.4640	20.6517	20.8136	20.9149	20.9477	20.9426	20.8695	20.6562	20.4097	20.2173	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.7348	19.7368	19.7388	19.7482	19.7500	19.7582	19.7582	19.7597	19.7550	19.7500	19.7464	19.7427	(88)
util rest of house													
	0.9939	0.9881	0.9721	0.9245	0.8114	0.6100	0.4095	0.4595	0.7478	0.9459	0.9879	0.9952	(89)
Tweekday	18.1738	18.3679	18.6946	19.1118	19.4425	19.6219	19.6598	19.6576	19.5558	19.1310	18.5817	18.1447	
Tweekend	18.1738	18.3679	18.6946	19.1118	19.4425	19.6219	19.6598	19.6576	19.5558	19.1310	18.5817	18.1447	
MIT 2	19.7348	19.7368	19.7388	19.7482	19.7500	19.7582	19.7582	19.7597	19.7550	19.7500	19.7464	19.7427	(90)
Living area fraction									fLA = Living area / (4) =			0.5009	(91)
MIT	20.3685	20.3695	20.3705	20.3752	20.3761	20.3802	20.3802	20.3810	20.3786	20.3761	20.3743	20.3725	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3685	20.3695	20.3705	20.3752	20.3761	20.3802	20.3802	20.3810	20.3786	20.3761	20.3743	20.3725	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9898	0.9762	0.9360	0.8403	0.6658	0.4841	0.5354	0.7940	0.9560	0.9899	0.9958	(94)
Useful gains	446.2752	512.4970	574.9209	617.4760	590.2276	459.0692	319.9425	332.4120	452.1556	475.7350	438.2423	423.8583	(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													
	1426.2051	1370.4841	1226.5775	1006.0278	759.3950	502.0942	328.3652	345.3155	546.9920	855.6749	1165.6874	1425.0576	(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													
	729.0678	576.5673	484.8325	279.7573	125.8606	0.0000	0.0000	0.0000	0.0000	282.6753	523.7605	744.8923	(98)
Space heating												3747.4137	(98)
Space heating per m2											(98) / (4) =	60.6869	(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 %)	295.7766	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1266.9745	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	729.0678	576.5673	484.8325	279.7573	125.8606	0.0000	0.0000	0.0000	0.0000	282.6753	523.7605	744.8923	(98)
Space heating efficiency (main heating system 1)													
	295.7766	295.7766	295.7766	295.7766	295.7766	0.0000	0.0000	0.0000	0.0000	295.7766	295.7766	295.7766	(210)
Space heating fuel (main heating system)													
	246.4928	194.9334	163.9185	94.5840	42.5526	0.0000	0.0000	0.0000	0.0000	95.5706	177.0798	251.8429	(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													
	187.8567	165.8288	174.7487	157.4717	154.9117	139.2737	134.5703	146.5449	145.9350	163.2488	171.5867	183.6140	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	166.9838	147.4034	155.3322	139.9748	137.6993	123.7988	119.6180	130.2621	129.7200	145.1101	152.5215	163.2124	(219)
Water heating fuel used												1711.6364	(219)
Annual totals kWh/year													
Space heating fuel - main system												1266.9745	(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)												286.4999	(232)
Total delivered energy for all uses												3265.1108	(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	1266.9745	0.5190	657.5598	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1711.6364	0.5190	888.3393	(264)
Space and water heating			1545.8991	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	286.4999	0.5190	148.6934	(268)
Total CO2, kg/year			1694.5925	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			27.4400	(273)

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

DER		27.4400	ZC1
Total Floor Area	TFA	61.7500	
Assumed number of occupants	N	2.0307	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.0181	ZC2
CO2 emissions from cooking, equation (L16)		2.7164	ZC3
Total CO2 emissions		47.1745	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		47.1745	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.7500 (1b)	x	2.4000 (2b)	=	148.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	61.7500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	148.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1350	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3850	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3272	(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	0.4172	0.4090	0.4008	0.3599	0.3518	0.3108	0.3108	0.3027	0.3272	0.3518	0.3681	0.3845	(22b)
Effective ac	0.5870	0.5836	0.5803	0.5648	0.5619	0.5483	0.5483	0.5458	0.5535	0.5619	0.5678	0.5739	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			12.3500	1.3258	16.3731			(27)
exposed floor			61.7500	0.1300	8.0275			(28b)
External Wall	71.2800	12.3500	58.9300	0.1800	10.6074			(29a)
corridor	12.0000	1.8900	10.1100	0.1800	1.8198			(29a)
External Roof 1	61.7500		61.7500	0.1300	8.0275			(30)
Total net area of external elements Aum(A, m2)			206.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.7453			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.1810 (36)
Total fabric heat loss	(33) + (36) =	62.9263 (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	28.7090	28.5438	28.3818	27.6209	27.4785	26.8158	26.8158	26.6931	27.0711	27.4785	27.7665	28.0676	(38)
Heat transfer coeff	91.6353	91.4701	91.3081	90.5472	90.4048	89.7421	89.7421	89.6194	89.9974	90.4048	90.6928	90.9939	(39)
Average = Sum(39)m / 12 =												90.5465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4840	1.4813	1.4787	1.4664	1.4640	1.4533	1.4533	1.4513	1.4574	1.4640	1.4687	1.4736	(40)
HLP (average)												1.4663	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.0307 (42)
Average daily hot water use (litres/day)	82.4281 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	90.6709	87.3738	84.0767	80.7795	77.4824	74.1853	74.1853	77.4824	80.7795	84.0767	87.3738	90.6709	(44)
Energy conte	134.4623	117.6016	121.3543	105.7997	101.5173	87.6017	81.1759	93.1505	94.2630	109.8544	119.9147	130.2196	(45)
Energy content (annual)										Total = Sum(45)m =		1296.9149	(45)
Distribution loss (46)m = 0.15 x (45)m	20.1694	17.6402	18.2032	15.8699	15.2276	13.1403	12.1764	13.9726	14.1394	16.4782	17.9872	19.5329	(46)

Water storage loss:	
Store volume	250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8903 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	189.3691	167.1948	176.2611	158.9353	156.4241	140.7373	136.0826	148.0573	147.3986	164.7612	173.0503	185.1264	(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													
	189.3691	167.1948	176.2611	158.9353	156.4241	140.7373	136.0826	148.0573	147.3986	164.7612	173.0503	185.1264	(64)
								Total per year (kWh/year) = Sum(64)m =				1943.3981	(64)
Heat gains from water heating, kWh/month													
	88.6342	78.7771	84.2757	77.6869	77.6799	71.6360	70.9164	74.8980	73.8509	80.4520	82.3801	87.2234	(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	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	101.5328	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9212	14.1410	11.5003	8.7064	6.5082	5.4945	5.9370	7.7171	10.3579	13.1517	15.3500	16.3637	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	177.3379	179.1781	174.5408	164.6686	152.2067	140.4943	132.6697	130.8295	135.4668	145.3390	157.8009	169.5133	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	33.1533	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	-81.2263	(71)
Water heating gains (Table 5)													
	119.1319	117.2279	113.2739	107.8984	104.4085	99.4945	95.3177	100.6693	102.5707	108.1344	114.4168	117.2358	(72)
Total internal gains													
	368.8509	367.0069	355.7748	337.7334	319.5833	301.9431	290.3843	295.6757	304.8552	323.0850	344.0275	359.5726	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.0400	19.6403	0.6300	0.7000	0.7700	30.2517	(76)
South	2.2700	46.7521	0.6300	0.7000	0.7700	32.4338	(78)
West	5.0400	19.6403	0.6300	0.7000	0.7700	30.2517	(80)

Solar gains	92.9372	171.4757	262.5811	360.7503	428.0819	433.3318	414.4684	364.4261	297.3798	197.7341	113.8858	77.7809	(83)
Total gains	461.7881	538.4826	618.3560	698.4836	747.6651	735.2749	704.8526	660.1019	602.2350	520.8191	457.9133	437.3535	(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	46.7963	46.8808	46.9640	47.3587	47.4332	47.7835	47.7835	47.8489	47.6480	47.4332	47.2826	47.1262	
alpha	4.1198	4.1254	4.1309	4.1572	4.1622	4.1856	4.1856	4.1899	4.1765	4.1622	4.1522	4.1417	
util living area													
	0.9950	0.9899	0.9766	0.9381	0.8505	0.6969	0.5373	0.5888	0.8190	0.9599	0.9904	0.9960	(86)
MIT	19.4647	19.6523	19.9667	20.3668	20.7052	20.9108	20.9767	20.9660	20.8160	20.3666	19.8398	19.4300	(87)
Th 2	19.6995	19.7016	19.7035	19.7128	19.7146	19.7227	19.7227	19.7242	19.7196	19.7146	19.7110	19.7074	(88)
util rest of house													
	0.9932	0.9865	0.9681	0.9146	0.7934	0.5893	0.3925	0.4423	0.7307	0.9399	0.9865	0.9946	(89)
MIT 2	17.6995	17.9732	18.4278	18.9963	19.4378	19.6669	19.7151	19.7117	19.5810	19.0097	18.2541	17.6541	(90)
Living area fraction									fLA = Living area / (4) =			0.5009	(91)
MIT	18.5837	18.8142	19.1986	19.6827	20.0727	20.2899	20.3470	20.3400	20.1996	19.6894	19.0484	18.5436	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5837	18.8142	19.1986	19.6827	20.0727	20.2899	20.3470	20.3400	20.1996	19.6894	19.0484	18.5436	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9911	0.9832	0.9638	0.9140	0.8112	0.6401	0.4656	0.5161	0.7677	0.9394	0.9837	0.9928	(94)
Useful gains	457.6808	529.4359	595.9674	638.4031	606.5184	470.6816	328.1526	340.6754	462.3574	489.2362	450.4295	434.2021	(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													
	1308.8894	1272.7356	1159.4854	976.3471	756.9288	510.6267	336.2675	353.0971	548.9488	821.7259	1083.6326	1305.1828	(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													
	633.2991	499.4974	419.2573	243.3197	111.9054	0.0000	0.0000	0.0000	0.0000	247.3724	455.9062	648.0096	(98)
Space heating												3258.5672	(98)
Space heating per m2											(98) / (4) =	52.7703	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3485.0986	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	633.2991	499.4974	419.2573	243.3197	111.9054	0.0000	0.0000	0.0000	0.0000	247.3724	455.9062	648.0096	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	677.3253	534.2218	448.4036	260.2349	119.6849	0.0000	0.0000	0.0000	0.0000	264.5694	487.6003	693.0584	(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													
	189.3691	167.1948	176.2611	158.9353	156.4241	140.7373	136.0826	148.0573	147.3986	164.7612	173.0503	185.1264	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7904	87.5558	87.0455	85.9467	83.9389	79.8000	79.8000	79.8000	79.8000	85.8956	87.2801	87.8816	(217)
Fuel for water heating, kWh/month													
	215.7061	190.9580	202.4932	184.9231	186.3548	176.3625	170.5296	185.5354	184.7100	191.8156	198.2701	210.6542	(219)
Water heating fuel used												2298.3126	(219)
Annual totals kWh/year													
Space heating fuel - main system												3485.0986	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												281.1728	(232)
Total delivered energy for all uses												6139.5841	(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	3485.0986	0.2160	752.7813	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2298.3126	0.2160	496.4355	(264)
Space and water heating			1249.2168	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.1728	0.5190	145.9287	(268)
Total CO2, kg/m2/year			1434.0705	(272)
Emissions per m2 for space and water heating			20.2302	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3632	(272b)
Emissions per m2 for pumps and fans			0.6304	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.2302 * 1.55) + 2.3632 + 0.6304, rounded to 2 d.p.			34.3500	(273)

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

Property Reference	4453-3	**Issued on Date**	30/07/2021
Assessment Reference	002	**Prop Type Ref**	
Property	3, Sibford Ferris		

SAP Rating	84 B	**DER**	17.32	**TER**	25.28
Environmental	86 B	**% DER<TER**	31.49		
CO_2 Emissions (t/year)	1.38	**DFEE**	41.99	**TFEE**	52.85
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.55		

Assessor Details	Mr. Harry Davey, energytest, Tel: 01892 315466, hdavey@energy-test.co.uk	**Assessor ID**	R434-0001
Client			

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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 98 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 25.28 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.32 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	0.82 (max. 2.00)	1.00 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 8.5kW PUHZ-W85VHA(2)-BS

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 5.94 m², No overhang
Windows facing South: 3.04 m², No overhang
Windows facing West: 10.31 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Window U-value 0.80 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9100 (1b)	x	2.5000 (2b)	=	122.2750 (1b) - (3b)	
First floor	48.9100 (1c)	x	2.7200 (2c)	=	133.0352 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.8200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.3102	(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							5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1958	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4458	(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) =	0.4124	(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	0.5258	0.5155	0.5052	0.4536	0.4433	0.3918	0.3918	0.3815	0.4124	0.4433	0.4640	0.4846	(22b)
Effective ac	0.6382	0.6329	0.6276	0.6029	0.5983	0.5767	0.5767	0.5728	0.5850	0.5983	0.6076	0.6174	(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	
Door			2.1000	1.0000	2.1000			(26)
Window (Uw = 0.80)			19.2900	0.7752	14.9535			(27)
floor			48.9100	0.1100	5.3801			(28a)
External Wall	104.3500	21.3900	82.9600	0.1500	12.4440			(29a)
External Roof 1	48.9100		48.9100	0.1100	5.3801			(30)
Total net area of external elements Aum(A, m2)			202.1700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.2577			(33)
Party Wall 1			44.6300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.8309	(36)
Total fabric heat loss (33) + (36) =	57.0886	(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	53.7732	53.3209	52.8776	50.7954	50.4058	48.5923	48.5923	48.2564	49.2908	50.4058	51.1939	52.0179	(38)
Heat transfer coeff	110.8618	110.4095	109.9662	107.8840	107.4944	105.6809	105.6809	105.3450	106.3794	107.4944	108.2825	109.1064	(39)
Average = Sum(39)m / 12 =												107.8821	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1333	1.1287	1.1242	1.1029	1.0989	1.0804	1.0804	1.0769	1.0875	1.0989	1.1070	1.1154	(40)
HLP (average)												1.1029	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7184 (42)
Average daily hot water use (litres/day)	98.7622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6384	104.6879	100.7374	96.7869	92.8365	88.8860	88.8860	92.8365	96.7869	100.7374	104.6879	108.6384	(44)
Energy conte	161.1076	140.9057	145.4021	126.7651	121.6341	104.9610	97.2618	111.6093	112.9423	131.6234	143.6772	156.0241	(45)
Energy content (annual)										Total = Sum(45)m =		1553.9137	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1661	21.1359	21.8103	19.0148	18.2451	15.7441	14.5893	16.7414	16.9413	19.7435	21.5516	23.4036	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.9720 (55)
Total storage loss
               30.1320    27.2160    30.1320    29.1600    30.1320    29.1600    30.1320    30.1320    29.1600    30.1320    29.1600    30.1320 (56)
If cylinder contains dedicated solar storage
               30.1320    27.2160    30.1320    29.1600    30.1320    29.1600    30.1320    30.1320    29.1600    30.1320    29.1600    30.1320 (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
              214.5020   189.1329   198.7965   178.4371   175.0285   156.6330   150.6562   165.0037   164.6143   185.0178   195.3492   209.4185 (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
              214.5020   189.1329   198.7965   178.4371   175.0285   156.6330   150.6562   165.0037   164.6143   185.0178   195.3492   209.4185 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2182.5897 (64)
Heat gains from water heating, kWh/month
               96.2838    85.4329    91.0617    83.4870    83.1589    76.2371    75.0551    79.8256    78.8909    86.4803    89.1103    94.5935 (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      135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204   135.9204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                23.1785    20.5869    16.7424    12.6751     9.4748     7.9990     8.6432    11.2348    15.0793    19.1466    22.3469    23.8227 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               252.7545   255.3773   248.7680   234.6974   216.9358   200.2424   189.0902   186.4674   193.0768   207.1474   224.9090   241.6023 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920    36.5920 (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)
              -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363  -108.7363 (71)
Water heating gains (Table 5)
               129.4137   127.1323   122.3948   115.9542   111.7727   105.8849   100.8805   107.2925   109.5707   116.2369   123.7643   127.1419 (72)
Total internal gains
               469.1228   466.8727   451.6813   427.1027   401.9594   377.9025   362.3900   368.7708   381.5029   406.3070   434.7962   456.3430 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.9400	19.6403	0.5700	0.7000	0.7700	32.2582	(76)
South	3.0400	46.7521	0.5700	0.7000	0.7700	39.2989	(78)
West	10.3100	19.6403	0.5700	0.7000	0.7700	55.9902	(80)

```
Solar gains    127.5473   236.9941   366.2864   507.2974   604.7110   613.1089   586.0297   513.5736   416.2973   274.2630   156.6180   106.5291 (83)
Total gains    596.6701   703.8668   817.9677   934.4002  1006.6704   991.0114   948.4197   882.3444   797.8002   680.5700   591.4142   562.8720 (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           61.2750    61.5260    61.7740    62.9663    63.1945    64.2790    64.2790    64.4839    63.8569    63.1945    62.7346    62.2608
alpha          5.0850     5.1017     5.1183     5.1978     5.2130     5.2853     5.2853     5.2989     5.2571     5.2130     5.1823     5.1507
util living area
                0.9979     0.9946     0.9837     0.9428     0.8361     0.6508     0.4844     0.5386     0.8032     0.9692     0.9952     0.9984 (86)

Tweekday       18.6868    18.8769    19.1803    19.5656    19.8163    19.9270    19.9402    19.9419    19.8829    19.5411    19.0586    18.6790
Tweekend       20.3790    20.4621    20.5963    20.7669    20.8921    20.9520    20.9642    20.9625    20.9227    20.7510    20.5361    20.3705
24 / 16            9          8          9          8          9          9          9          9          8          9          8          9
24 / 9            22         20         22         22         22         21         22         22         22         22         22         22
16 / 9             0          0          0          0          0          0          0          0          0          0          0          0
MIT           21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000    21.0000 (87)
Th 2          19.9737    19.9775    19.9811    19.9985    20.0017    20.0169    20.0169    20.0197    20.0111    20.0017    19.9952    19.9883 (88)
util rest of house
                0.9971     0.9928     0.9781     0.9229     0.7846     0.5638     0.3793     0.4293     0.7265     0.9545     0.9932     0.9979 (89)
Tweekday       18.6868    18.8769    19.1803    19.5656    19.8163    19.9270    19.9402    19.9419    19.8829    19.5411    19.0586    18.6790
Tweekend       18.6868    18.8769    19.1803    19.5656    19.8163    19.9270    19.9402    19.9419    19.8829    19.5411    19.0586    18.6790
MIT 2          19.9737    19.9775    19.9811    19.9985    20.0017    20.0169    20.0169    20.0197    20.0111    20.0017    19.9952    19.9883 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.2494 (91)
MIT           20.2297    20.2325    20.2353    20.2483    20.2507    20.2621    20.2621    20.2642    20.2577    20.2507    20.2458    20.2407 (92)
Temperature adjustment                                                                                          0.0000
adjusted MIT  20.2297    20.2325    20.2353    20.2483    20.2507    20.2621    20.2621    20.2642    20.2577    20.2507    20.2458    20.2407 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9973     0.9933     0.9797     0.9285     0.7986     0.5865     0.4059     0.4572     0.7475     0.9588     0.9938     0.9980 (94)
Useful gains  595.0818   699.1711   801.3323   867.5642   803.9366   581.1799   385.0021   403.4132   596.3926   652.5226   587.7516   561.7636 (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
              1765.9956  1692.8563  1510.4171  1224.2994   919.1564   598.3783   387.0166   407.0783   655.0561  1037.4003  1423.4605  1750.1384 (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
               871.1598   667.7565   527.5591   256.8494    85.7235     0.0000     0.0000     0.0000     0.0000   286.3490   601.7104   884.1509 (98)
Space heating                                                                                                  4181.2585 (98)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 42.7444 (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 %)												246.0261	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												1699.5180	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	871.1598	667.7565	527.5591	256.8494	85.7235	0.0000	0.0000	0.0000	0.0000	286.3490	601.7104	884.1509	(98)
Space heating efficiency (main heating system 1)													
	246.0261	246.0261	246.0261	246.0261	246.0261	0.0000	0.0000	0.0000	0.0000	246.0261	246.0261	246.0261	(210)
Space heating fuel (main heating system)													
	354.0924	271.4169	214.4321	104.3992	34.8433	0.0000	0.0000	0.0000	0.0000	116.3897	244.5717	359.3727	(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													
	214.5020	189.1329	198.7965	178.4371	175.0285	156.6330	150.6562	165.0037	164.6143	185.0178	195.3492	209.4185	(64)
Efficiency of water heater												188.9550	(216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	(217)
Fuel for water heating, kWh/month													
	113.5202	100.0942	105.2084	94.4336	92.6297	82.8943	79.7313	87.3243	87.1183	97.9163	103.3840	110.8298	(219)
Water heating fuel used												1155.0844	(219)
Annual totals kWh/year													
Space heating fuel - main system												1699.5180	(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)												409.3390	(232)
Total delivered energy for all uses												3263.9414	(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	1699.5180	0.5190	882.0499	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1155.0844	0.5190	599.4888	(264)
Space and water heating			1481.5387	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	409.3390	0.5190	212.4469	(268)
Total CO2, kg/year			1693.9856	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3200	(273)

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

DER		17.3200	ZC1
Total Floor Area	TFA	97.8200	
Assumed number of occupants	N	2.7184	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3115	ZC2
CO2 emissions from cooking, equation (L16)		1.8835	ZC3
Total CO2 emissions		34.5150	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.5150	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9100 (1b)	x	2.5000 (2b)	=	122.2750	(1b) - (3b)
First floor	48.9100 (1c)	x	2.7200 (2c)	=	133.0352	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.8200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.3102	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1175	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3675	(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) =	0.3399	(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	0.4334	0.4249	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5903	0.5867	0.5699	0.5668	0.5521	0.5521	0.5494	0.5578	0.5668	0.5731	0.5798	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.40)			19.2900	1.3258	25.5739			(27)
floor			48.9100	0.1300	6.3583			(28a)
External Wall	104.3500	21.3900	82.9600	0.1800	14.9328			(29a)
External Roof 1	48.9100		48.9100	0.1300	6.3583			(30)
Total net area of external elements Aum(A, m2)			202.1700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.3233			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.3708	(36)
Total fabric heat loss	(33) + (36) =	65.6941	(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	50.0399	49.7326	49.4314	48.0166	47.7519	46.5196	46.5196	46.2915	46.9943	47.7519	48.2874	48.8472	(38)
Heat transfer coeff	115.7340	115.4267	115.1254	113.7107	113.4460	112.2137	112.2137	111.9855	112.6884	113.4460	113.9814	114.5413	(39)
Average = Sum(39)m / 12 =												113.7094	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1831	1.1800	1.1769	1.1624	1.1597	1.1471	1.1471	1.1448	1.1520	1.1597	1.1652	1.1709	(40)
HLP (average)												1.1624	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7184	(42)
Average daily hot water use (litres/day)	98.7622	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6384	104.6879	100.7374	96.7869	92.8365	88.8860	88.8860	92.8365	96.7869	100.7374	104.6879	108.6384	(44)
Energy conte	161.1076	140.9057	145.4021	126.7651	121.6341	104.9610	97.2618	111.6093	112.9423	131.6234	143.6772	156.0241	(45)
Energy content (annual)										Total = Sum(45)m =		1553.9137	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1661	21.1359	21.8103	19.0148	18.2451	15.7441	14.5893	16.7414	16.9413	19.7435	21.5516	23.4036	(46)

Water storage loss:		
Store volume	250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8903	(48)
Temperature factor from Table 2b	0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(64)
								Total per year (kWh/year) = Sum(64)m =				2200.3969	(64)
Heat gains from water heating, kWh/month													
	97.4937	86.5257	92.2716	84.6579	84.3688	77.4080	76.2650	81.0355	80.0618	87.6902	90.2811	95.8035	(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	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7268	20.1858	16.4162	12.4281	9.2901	7.8431	8.4748	11.0158	14.7854	18.7735	21.9115	23.3585	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.7545	255.3773	248.7680	234.6974	216.9358	200.2424	189.0902	186.4674	193.0768	207.1474	224.9090	241.6023	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	(71)
Water heating gains (Table 5)													
	131.0399	128.7585	124.0210	117.5804	113.3989	107.5111	102.5067	108.9187	111.1969	117.8632	125.3905	128.7681	(72)
Total internal gains													
	473.2974	471.0978	455.9813	431.4820	406.4010	382.3728	366.8478	373.1781	385.8353	410.5602	438.9870	460.5050	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.9400	19.6403	0.6300	0.7000	0.7700	35.6538	(76)
South	3.0400	46.7521	0.6300	0.7000	0.7700	43.4356	(78)
West	10.3100	19.6403	0.6300	0.7000	0.7700	61.8839	(80)

Solar gains	140.9733	261.9408	404.8429	560.6972	668.3648	677.6467	647.7170	567.6339	460.1180	303.1328	173.1041	117.7426	(83)
Total gains	614.2707	733.0386	860.8241	992.1791	1074.7658	1060.0195	1014.5648	940.8120	845.9533	713.6930	612.0911	578.2476	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.6954	58.8517	59.0057	59.7398	59.8792	60.5368	60.5368	60.6601	60.2818	59.8792	59.5979	59.3066	
alpha	4.9130	4.9234	4.9337	4.9827	4.9919	5.0358	5.0358	5.0440	5.0188	4.9919	4.9732	4.9538	
util living area													
	0.9976	0.9938	0.9812	0.9363	0.8253	0.6435	0.4799	0.5353	0.7968	0.9662	0.9946	0.9982	(86)
MIT	19.7403	19.9211	20.2121	20.5719	20.8390	20.9654	20.9934	20.9890	20.9007	20.5301	20.0659	19.7116	(87)
Th 2	19.9335	19.9360	19.9385	19.9502	19.9523	19.9625	19.9625	19.9644	19.9586	19.9523	19.9479	19.9433	(88)
util rest of house													
	0.9967	0.9917	0.9746	0.9143	0.7709	0.5530	0.3703	0.4210	0.7167	0.9501	0.9924	0.9976	(89)
MIT 2	18.2603	18.5254	18.9476	19.4600	19.8012	19.9407	19.9602	19.9601	19.8828	19.4149	18.7461	18.2253	(90)
Living area fraction										fLA = Living area / (4) =		0.2494	(91)
MIT	18.6295	18.8735	19.2630	19.7373	20.0600	20.1963	20.2179	20.2167	20.1367	19.6931	19.0753	18.5960	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6295	18.8735	19.2630	19.7373	20.0600	20.1963	20.2179	20.2167	20.1367	19.6931	19.0753	18.5960	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9887	0.9691	0.9089	0.7771	0.5744	0.3978	0.4496	0.7320	0.9450	0.9897	0.9964	(94)
Useful gains	611.3229	724.7245	834.2171	901.8110	835.1656	608.8347	403.5554	423.0222	619.2080	674.4081	605.7838	576.1535	(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													
	1658.4060	1612.9193	1469.3468	1232.3201	948.4114	627.9772	405.9830	427.4195	680.2696	1031.5731	1364.9671	1648.9395	(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													
	779.0299	596.8669	472.5365	237.9666	84.2549	0.0000	0.0000	0.0000	0.0000	265.7308	546.6120	798.1528	(98)
Space heating												3781.1504	(98)
Space heating per m2											(98) / (4) =	38.6542	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4044.0111	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	779.0299	596.8669	472.5365	237.9666	84.2549	0.0000	0.0000	0.0000	0.0000	265.7308	546.6120	798.1528	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	833.1870	638.3603	505.3866	254.5097	90.1122	0.0000	0.0000	0.0000	0.0000	284.2041	584.6118	853.6393	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9402	87.6563	87.0261	85.5609	82.9692	79.8000	79.8000	79.8000	79.8000	85.7574	87.3976	88.0326	(217)
Fuel for water heating, kWh/month													
	245.6379	217.3249	230.1710	210.2605	212.7789	198.1160	190.6874	208.6668	208.1177	217.5090	225.1924	239.6054	(219)
Water heating fuel used												2604.0679	(219)
Annual totals kWh/year													
Space heating fuel - main system												4044.0111	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												401.3627	(232)
Total delivered energy for all uses												7124.4417	(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	4044.0111	0.2160	873.5064	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.0679	0.2160	562.4787	(264)
Space and water heating			1435.9851	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	401.3627	0.5190	208.3072	(268)
Total CO2, kg/m2/year			1683.2173	(272)
Emissions per m2 for space and water heating			14.6799	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1295	(272b)
Emissions per m2 for pumps and fans			0.3979	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6799 * 1.55) + 2.1295 + 0.3979, rounded to 2 d.p.			25.2800	(273)

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

Property Reference	4453-9	**Issued on Date**	30/07/2021
Assessment Reference	002	**Prop Type Ref**	
Property	9, Sibford Ferris		

SAP Rating	84 B	**DER**	17.92	**TER**	25.67
Environmental	85 B	**% DER<TER**	30.19		
CO_2 Emissions (t/year)	1.42	**DFEE**	43.90	**TFEE**	53.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.41		

Assessor Details	Mr. Harry Davey, energytest, Tel: 01892 315466, hdavey@energy-test.co.uk	**Assessor ID**	R434-0001
Client			

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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 98 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 25.67 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.92 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	0.82 (max. 2.00)	1.00 (max. 3.30)	OK

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

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 8.5kW PUHZ-W85VHA(2)-BS

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 0.94 m², No overhang
Windows facing East: 5.94 m², No overhang
Windows facing West: 10.31 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Window U-value 0.80 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9100	(1b)	x 2.5000	(2b) =	122.2750	(1b) - (3b)
First floor	48.9100	(1c)	x 2.7200	(2c) =	133.0352	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.8200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		255.3102	(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							5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1958	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4458	(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) =	0.4124	(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	0.5258	0.5155	0.5052	0.4536	0.4433	0.3918	0.3918	0.3815	0.4124	0.4433	0.4640	0.4846	(22b)
Effective ac	0.6382	0.6329	0.6276	0.6029	0.5983	0.5767	0.5767	0.5728	0.5850	0.5983	0.6076	0.6174	(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	
Door			2.1000	1.0000	2.1000			(26)
Window (Uw = 0.80)			17.1900	0.7752	13.3256			(27)
floor			48.9100	0.1100	5.3801			(28a)
External Wall	104.3500	19.2900	85.0600	0.1500	12.7590			(29a)
External Roof 1	48.9100		48.9100	0.1100	5.3801			(30)
Total net area of external elements Aum(A, m2)			202.1700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9448			(33)
Party Wall 1			44.6300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	17.7199	(36)
Total fabric heat loss (33) + (36) =	56.6647	(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	53.7732	53.3209	52.8776	50.7954	50.4058	48.5923	48.5923	48.2564	49.2908	50.4058	51.1939	52.0179	(38)
Heat transfer coeff	110.4379	109.9856	109.5423	107.4601	107.0705	105.2569	105.2569	104.9211	105.9555	107.0705	107.8586	108.6825	(39)
Average = Sum(39)m / 12 =												107.4582	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1290	1.1244	1.1198	1.0985	1.0946	1.0760	1.0760	1.0726	1.0832	1.0946	1.1026	1.1110	(40)
HLP (average)												1.0985	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7184 (42)
Average daily hot water use (litres/day)	98.7622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6384	104.6879	100.7374	96.7869	92.8365	88.8860	88.8860	92.8365	96.7869	100.7374	104.6879	108.6384	(44)
Energy conte	161.1076	140.9057	145.4021	126.7651	121.6341	104.9610	97.2618	111.6093	112.9423	131.6234	143.6772	156.0241	(45)
Energy content (annual)										Total = Sum(45)m =		1553.9137	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1661	21.1359	21.8103	19.0148	18.2451	15.7441	14.5893	16.7414	16.9413	19.7435	21.5516	23.4036	(46)

Water storage loss:	
Store volume	250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8000 (48)

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	214.5020	189.1329	198.7965	178.4371	175.0285	156.6330	150.6562	165.0037	164.6143	185.0178	195.3492	209.4185	(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													
	214.5020	189.1329	198.7965	178.4371	175.0285	156.6330	150.6562	165.0037	164.6143	185.0178	195.3492	209.4185	(64)
								Total per year (kWh/year) = Sum(64)m =				2182.5897	(64)
Heat gains from water heating, kWh/month													
	96.2838	85.4329	91.0617	83.4870	83.1589	76.2371	75.0551	79.8256	78.8909	86.4803	89.1103	94.5935	(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	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6976	21.0480	17.1174	12.9590	9.6870	8.1781	8.8368	11.4864	15.4170	19.5754	22.8474	24.3562	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.7545	255.3773	248.7680	234.6974	216.9358	200.2424	189.0902	186.4674	193.0768	207.1474	224.9090	241.6023	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	(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)													
	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	(71)
Water heating gains (Table 5)													
	129.4137	127.1323	122.3948	115.9542	111.7727	105.8849	100.8805	107.2925	109.5707	116.2369	123.7643	127.1419	(72)
Total internal gains													
	469.6420	467.3338	452.0562	427.3866	402.1716	378.0816	362.5836	369.0224	381.8406	406.7359	435.2967	456.8765	(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	0.9400	10.6334	0.5700	0.7000	0.7700	2.7638	(74)
East	5.9400	19.6403	0.5700	0.7000	0.7700	32.2582	(76)
West	10.3100	19.6403	0.5700	0.7000	0.7700	55.9902	(80)

Solar gains	91.0122	177.9143	293.2763	429.0526	527.5724	540.9741	514.6466	440.8003	341.4450	211.1303	113.4449	74.8752	(83)
Total gains	560.6541	645.2481	745.3325	856.4392	929.7440	919.0557	877.2302	809.8227	723.2856	617.8662	548.7416	531.7517	(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	61.5102	61.7631	62.0131	63.2147	63.4447	64.5378	64.5378	64.7444	64.1123	63.4447	62.9811	62.5037	
alpha	5.1007	5.1175	5.1342	5.2143	5.2296	5.3025	5.3025	5.3163	5.2742	5.2296	5.1987	5.1669	
util living area													
	0.9984	0.9964	0.9890	0.9582	0.8668	0.6891	0.5194	0.5800	0.8451	0.9790	0.9966	0.9988	(86)
Tweekday	18.6586	18.8261	19.1193	19.5151	19.7943	19.9260	19.9434	19.9445	19.8685	19.4938	19.0231	18.6557	
Tweekend	20.3653	20.4382	20.5674	20.7410	20.8772	20.9479	20.9633	20.9609	20.9102	20.7273	20.5191	20.3590	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9772	19.9810	19.9847	20.0020	20.0053	20.0205	20.0205	20.0233	20.0146	20.0053	19.9987	19.9918	(88)
util rest of house													
	0.9978	0.9951	0.9850	0.9426	0.8202	0.6010	0.4083	0.4649	0.7749	0.9685	0.9952	0.9984	(89)
Tweekday	18.6586	18.8261	19.1193	19.5151	19.7943	19.9260	19.9434	19.9445	19.8685	19.4938	19.0231	18.6557	
Tweekend	18.6586	18.8261	19.1193	19.5151	19.7943	19.9260	19.9434	19.9445	19.8685	19.4938	19.0231	18.6557	
MIT 2	19.9772	19.9810	19.9847	20.0020	20.0053	20.0205	20.0205	20.0233	20.0146	20.0053	19.9987	19.9918	(90)
Living area fraction									fLA = Living area / (4) =			0.2494	(91)
MIT	20.2323	20.2352	20.2379	20.2510	20.2534	20.2648	20.2648	20.2669	20.2604	20.2534	20.2485	20.2433	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2323	20.2352	20.2379	20.2510	20.2534	20.2648	20.2648	20.2669	20.2604	20.2534	20.2485	20.2433	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9955	0.9861	0.9470	0.8331	0.6242	0.4366	0.4946	0.7945	0.9716	0.9956	0.9985	(94)
Useful gains	559.5348	642.3239	734.9916	811.0423	774.5466	573.6632	382.9580	400.5189	574.6851	600.2976	546.3188	530.9516	(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													
	1759.5344	1686.6473	1504.8843	1219.7742	915.8163	596.2589	385.7450	405.7204	652.7281	1033.5938	1418.1741	1743.6266	(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													
	892.7997	701.7853	572.8002	294.2870	105.1046	0.0000	0.0000	0.0000	0.0000	322.3724	627.7358	902.2302	(98)
Space heating												4419.1152	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 45.1760 (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 %)	245.0514 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	1803.3423 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	892.7997	701.7853	572.8002	294.2870	105.1046	0.0000	0.0000	0.0000	0.0000	322.3724	627.7358	902.2302	(98)
Space heating efficiency (main heating system 1)	245.0514	245.0514	245.0514	245.0514	245.0514	0.0000	0.0000	0.0000	0.0000	245.0514	245.0514	245.0514	(210)
Space heating fuel (main heating system)	364.3316	286.3829	233.7470	120.0919	42.8909	0.0000	0.0000	0.0000	0.0000	131.5530	256.1650	368.1800	(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	214.5020	189.1329	198.7965	178.4371	175.0285	156.6330	150.6562	165.0037	164.6143	185.0178	195.3492	209.4185	(64)
Efficiency of water heater												188.9550	(216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	(217)
Fuel for water heating, kWh/month	113.5202	100.0942	105.2084	94.4336	92.6297	82.8943	79.7313	87.3243	87.1183	97.9163	103.3840	110.8298	(219)
Water heating fuel used												1155.0844	(219)

Annual totals kWh/year	
Space heating fuel - main system	1803.3423 (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)	418.5067 (232)
Total delivered energy for all uses	3376.9334 (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	1803.3423	0.5190	935.9346	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1155.0844	0.5190	599.4888	(264)
Space and water heating			1535.4234	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	418.5067	0.5190	217.2050	(268)
Total CO2, kg/year			1752.6284	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.9200	(273)

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

DER		17.9200	ZC1
Total Floor Area	TFA	97.8200	
Assumed number of occupants	N	2.7184	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3115	ZC2
CO2 emissions from cooking, equation (L16)		1.8835	ZC3
Total CO2 emissions		35.1150	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.1150	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.9100 (1b)	x	2.5000 (2b)	=	122.2750	(1b) - (3b)
First floor	48.9100 (1c)	x	2.7200 (2c)	=	133.0352	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.8200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.3102	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1175	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3675	(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) =	0.3399	(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	0.4334	0.4249	0.4164	0.3739	0.3654	0.3229	0.3229	0.3144	0.3399	0.3654	0.3824	0.3994	(22b)
Effective ac	0.5939	0.5903	0.5867	0.5699	0.5668	0.5521	0.5521	0.5494	0.5578	0.5668	0.5731	0.5798	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.40)			17.1900	1.3258	22.7898			(27)
floor			48.9100	0.1300	6.3583			(28a)
External Wall	104.3500	19.2900	85.0600	0.1800	15.3108			(29a)
External Roof 1	48.9100		48.9100	0.1300	6.3583			(30)
Total net area of external elements Aum(A, m2)			202.1700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.9172			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.0808	(36)
Total fabric heat loss					(33) + (36) =		62.9980	(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	50.0399	49.7326	49.4314	48.0166	47.7519	46.5196	46.5196	46.2915	46.9943	47.7519	48.2874	48.8472	(38)
Heat transfer coeff	113.0379	112.7306	112.4294	111.0146	110.7499	109.5176	109.5176	109.2894	109.9923	110.7499	111.2854	111.8452	(39)
Average = Sum(39)m / 12 =												111.0133	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1556	1.1524	1.1493	1.1349	1.1322	1.1196	1.1196	1.1173	1.1244	1.1322	1.1377	1.1434	(40)
HLP (average)												1.1349	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7184	(42)
Average daily hot water use (litres/day)												98.7622	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6384	104.6879	100.7374	96.7869	92.8365	88.8860	88.8860	92.8365	96.7869	100.7374	104.6879	108.6384	(44)
Energy conte	161.1076	140.9057	145.4021	126.7651	121.6341	104.9610	97.2618	111.6093	112.9423	131.6234	143.6772	156.0241	(45)
Energy content (annual)										Total = Sum(45)m =		1553.9137	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1661	21.1359	21.8103	19.0148	18.2451	15.7441	14.5893	16.7414	16.9413	19.7435	21.5516	23.4036	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(64)
									Total per year (kWh/year) = Sum(64)m =			2200.3969	(64)
Heat gains from water heating, kWh/month													
	97.4937	86.5257	92.2716	84.6579	84.3688	77.4080	76.2650	81.0355	80.0618	87.6902	90.2811	95.8035	(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	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	135.9204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.1055	20.5221	16.6897	12.6352	9.4449	7.9738	8.6160	11.1994	15.0318	19.0863	22.2766	23.7477	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	252.7545	255.3773	248.7680	234.6974	216.9358	200.2424	189.0902	186.4674	193.0768	207.1474	224.9090	241.6023	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	36.5920	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	-108.7363	(71)
Water heating gains (Table 5)													
	131.0399	128.7585	124.0210	117.5804	113.3989	107.5111	102.5067	108.9187	111.1969	117.8632	125.3905	128.7681	(72)
Total internal gains													
	473.6761	471.4341	456.2548	431.6891	406.5558	382.5035	366.9890	373.3617	386.0817	410.8730	439.3521	460.8942	(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	0.9400	10.6334	0.6300	0.7000	0.7700	3.0547	(74)
East	5.9400	19.6403	0.6300	0.7000	0.7700	35.6538	(76)
West	10.3100	19.6403	0.6300	0.7000	0.7700	61.8839	(80)

Solar gains	100.5924	196.6422	324.1474	474.2160	583.1063	597.9187	568.8199	487.2003	377.3866	233.3546	125.3864	82.7568	(83)
Total gains	574.2685	668.0763	780.4023	905.9051	989.6621	980.4222	935.8089	860.5620	763.4682	644.2276	564.7386	543.6511	(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	60.0954	60.2592	60.4207	61.1907	61.3369	62.0271	62.0271	62.1566	61.7594	61.3369	61.0418	60.7362	
alpha	5.0064	5.0173	5.0280	5.0794	5.0891	5.1351	5.1351	5.1438	5.1173	5.0891	5.0695	5.0491	
util living area													
	0.9982	0.9958	0.9870	0.9516	0.8520	0.6732	0.5065	0.5683	0.8340	0.9764	0.9962	0.9986	(86)
MIT	19.7392	19.8967	20.1743	20.5367	20.8201	20.9605	20.9924	20.9868	20.8821	20.4965	20.0529	19.7157	(87)
Th 2	19.9557	19.9582	19.9607	19.9724	19.9746	19.9849	19.9849	19.9868	19.9809	19.9746	19.9702	19.9656	(88)
util rest of house													
	0.9976	0.9943	0.9823	0.9338	0.8020	0.5831	0.3941	0.4511	0.7603	0.9646	0.9946	0.9982	(89)
MIT 2	18.2745	18.5060	18.9105	19.4321	19.8016	19.9593	19.9821	19.9814	19.8871	19.3866	18.7432	18.2470	(90)
Living area fraction									fLA = Living area / (4) =			0.2494	(91)
MIT	18.6398	18.8529	19.2257	19.7076	20.0556	20.2091	20.2341	20.2322	20.1353	19.6635	19.0699	18.6134	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6398	18.8529	19.2257	19.7076	20.0556	20.2091	20.2341	20.2322	20.1353	19.6635	19.0699	18.6134	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9921	0.9779	0.9282	0.8065	0.6041	0.4223	0.4805	0.7730	0.9598	0.9925	0.9973	(94)
Useful gains	572.2085	662.8114	763.1165	840.8665	798.1476	592.2429	395.1514	413.4636	590.1648	618.3330	560.5177	542.1589	(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													
	1620.9452	1572.9146	1430.7472	1199.7998	925.3861	614.2903	398.0020	418.8205	663.8388	1003.7759	1332.0736	1612.0664	(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													
	780.2601	611.5894	496.7172	258.4320	94.6654	0.0000	0.0000	0.0000	0.0000	286.7696	555.5202	796.0111	(98)
Space heating												3879.9650	(98)
Space heating per m2											(98) / (4) =	39.6643	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4149.6952	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	780.2601	611.5894	496.7172	258.4320	94.6654	0.0000	0.0000	0.0000	0.0000	286.7696	555.5202	796.0111	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	834.5028	654.1063	531.2484	276.3978	101.2465	0.0000	0.0000	0.0000	0.0000	306.7054	594.1393	851.3488	(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													
	216.0144	190.4990	200.3089	179.9007	176.5409	158.0966	152.1686	166.5161	166.0779	186.5301	196.8128	210.9309	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9433	87.7069	87.1422	85.7794	83.2350	79.8000	79.8000	79.8000	79.8000	85.9577	87.4331	88.0275	(217)
Fuel for water heating, kWh/month													
	245.6293	217.1995	229.8645	209.7247	212.0992	198.1160	190.6874	208.6668	208.1177	217.0023	225.1010	239.6193	(219)
Water heating fuel used												2601.8278	(219)
Annual totals kWh/year													
Space heating fuel - main system												4149.6952	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												408.0507	(232)
Total delivered energy for all uses												7234.5738	(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	4149.6952	0.2160	896.3342	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2601.8278	0.2160	561.9948	(264)
Space and water heating			1458.3290	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	408.0507	0.5190	211.7783	(268)
Total CO2, kg/m2/year			1709.0323	(272)
Emissions per m2 for space and water heating			14.9083	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1650	(272b)
Emissions per m2 for pumps and fans			0.3979	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9083 * 1.55) + 2.1650 + 0.3979, rounded to 2 d.p.			25.6700	(273)

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

Property Reference	4453-14	**Issued on Date**	30/07/2021
Assessment Reference	001	**Prop Type Ref**	
Property	14, Sibford Ferris		

SAP Rating	79 C	**DER**	18.14	**TER**	21.06
Environmental	82 B	**% DER<TER**	13.88		
CO_2 Emissions (t/year)	2.91	**DFEE**	51.30	**TFEE**	52.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.07		

Assessor Details	Mr. Harry Davey, energytest, Tel: 01892 315466, hdavey@energy-test.co.uk	**Assessor ID**	R434-0001
Client			

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r17

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

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

Semi-Detached House, total floor area 198 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.06 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.14 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: Room heaters - Wood Logs

Closed room heater
Efficiency: 65%
Minimum: 65% OK

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 15.48 m², No overhang
Windows facing East: 2.23 m², No overhang
Windows facing South: 12.47 m², No overhang
Windows facing West: 5.50 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.10 W/m²K
Secondary heating (wood logs)
Secondary heating fuel: wood logs

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9000 (1b)	x	2.5000 (2b)	=	247.2500	(1b) - (3b)
First floor	98.9000 (1c)	x	2.7200 (2c)	=	269.0080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	197.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.2580	(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	+	1	=	1 * 20 =	20.0000	(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) =	80.0000 / (5) =	0.1550 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.4050 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3442 (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	0.4389	0.4303	0.4217	0.3786	0.3700	0.3270	0.3270	0.3184	0.3442	0.3700	0.3872	0.4045	(22b)
Effective ac	0.5963	0.5926	0.5889	0.5717	0.5685	0.5535	0.5535	0.5507	0.5592	0.5685	0.5750	0.5818	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Door			2.5200	1.4000	3.5280			(26)
Window (Uw = 1.40)			35.6800	1.3258	47.3030			(27)
floor			98.9000	0.1000	9.8900			(28a)
External Wall	193.0400	38.2000	154.8400	0.2500	38.7100			(29a)
External Roof 1	98.9000		98.9000	0.1300	12.8570			(30)
Total net area of external elements Aum(A, m2)			390.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.2880			(33)
Party Wall 1			32.9900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.8860	(36)
Total fabric heat loss (33) + (36) =	133.1740	(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	101.5898	100.9527	100.3282	97.3950	96.8462	94.2914	94.2914	93.8183	95.2755	96.8462	97.9564	99.1171	(38)
Heat transfer coeff	234.7639	234.1267	233.5022	230.5690	230.0202	227.4654	227.4654	226.9923	228.4495	230.0202	231.1304	232.2911	(39)
Average = Sum(39)m / 12 =												230.5664	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1869	1.1837	1.1805	1.1657	1.1629	1.1500	1.1500	1.1476	1.1550	1.1629	1.1685	1.1744	(40)
HLP (average)												1.1657	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9991 (42)
Average daily hot water use (litres/day)	105.4276 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.9704	111.7533	107.5362	103.3190	99.1019	94.8848	94.8848	99.1019	103.3190	107.5362	111.7533	115.9704	(44)
Energy conte	171.9807	150.4154	155.2152	135.3204	129.8431	112.0448	103.8259	119.1418	120.5647	140.5066	153.3739	166.5541	(45)
Energy content (annual)										Total = Sum(45)m =		1658.7867	(45)
Distribution loss (46)m = 0.15 x (45)m	25.7971	22.5623	23.2823	20.2981	19.4765	16.8067	15.5739	17.8713	18.0847	21.0760	23.0061	24.9831	(46)

Water storage loss:	
Store volume	250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8000 (48)

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	225.3751	198.6426	208.6096	186.9924	183.2375	163.7168	157.2203	172.5362	172.2367	193.9010	205.0459	219.9485	(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													
	225.3751	198.6426	208.6096	186.9924	183.2375	163.7168	157.2203	172.5362	172.2367	193.9010	205.0459	219.9485	(64)
								Total per year (kWh/year) = Sum(64)m =				2287.4627	(64)
Heat gains from water heating, kWh/month													
	99.8991	88.5949	94.3246	86.3316	85.8884	78.5925	77.2376	82.3302	81.4254	89.4340	92.3344	98.0948	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.5832	29.8283	24.2580	18.3649	13.7279	11.5897	12.5231	16.2780	21.8483	27.7414	32.3783	34.5166	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	368.9497	372.7782	363.1304	342.5914	316.6645	292.2970	276.0179	272.1894	281.8372	302.3762	328.3031	352.6706	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	(71)
Water heating gains (Table 5)													
	134.2730	131.8376	126.7804	119.9050	115.4414	109.1562	103.8140	110.6588	113.0908	120.2069	128.2422	131.8478	(72)
Total internal gains													
	607.7917	605.4300	585.1546	551.8471	516.8197	484.0287	463.3409	470.1120	487.7621	521.3104	559.9095	590.0208	(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	15.4800	10.6334	0.6300	0.7000	0.7700	50.3054	(74)
East	2.2300	19.6403	0.6300	0.7000	0.7700	13.3852	(76)
South	12.4700	46.7521	0.6300	0.7000	0.7700	178.1718	(78)
West	5.5000	19.6403	0.6300	0.7000	0.7700	33.0128	(80)

Solar gains	274.8752	478.7000	684.5355	900.5004	1058.4137	1073.1939	1025.2977	903.7014	758.5422	536.8702	331.1054	234.0493	(83)
Total gains	882.6669	1084.1299	1269.6901	1452.3475	1575.2334	1557.2227	1488.6386	1373.8135	1246.3043	1058.1806	891.0148	824.0702	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5103	58.6696	58.8265	59.5748	59.7170	60.3877	60.3877	60.5135	60.1276	59.7170	59.4301	59.1332	
alpha	4.9007	4.9113	4.9218	4.9717	4.9811	5.0258	5.0258	5.0342	5.0085	4.9811	4.9620	4.9422	
util living area													
	0.9995	0.9984	0.9950	0.9809	0.9316	0.8047	0.6394	0.7034	0.9146	0.9903	0.9988	0.9996	(86)
MIT	19.8699	19.9937	20.1932	20.4606	20.7069	20.8738	20.9285	20.9184	20.7906	20.4679	20.1209	19.8536	(87)
Th 2	19.9305	19.9331	19.9356	19.9476	19.9498	19.9602	19.9602	19.9622	19.9562	19.9498	19.9453	19.9406	(88)
util rest of house													
	0.9993	0.9979	0.9930	0.9727	0.8999	0.7185	0.5045	0.5711	0.8617	0.9849	0.9982	0.9995	(89)
MIT 2	18.4053	18.5884	18.8816	19.2776	19.6202	19.8288	19.8742	19.8706	19.7393	19.2933	18.7842	18.3892	(90)
Living area fraction										fLA = Living area / (4) =		0.1481	(91)
MIT	18.6222	18.7965	19.0759	19.4528	19.7812	19.9835	20.0303	20.0258	19.8950	19.4672	18.9822	18.6061	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6222	18.7965	19.0759	19.4528	19.7812	19.9835	20.0303	20.0258	19.8950	19.4672	18.9822	18.6061	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9970	0.9908	0.9675	0.8936	0.7208	0.5143	0.5800	0.8577	0.9813	0.9975	0.9993	(94)
Useful gains	881.7396	1080.8514	1257.9782	1405.1683	1407.5843	1122.3731	765.5336	796.8165	1068.9296	1038.4131	888.7538	823.4601	(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													
	3362.3299	3253.5521	2936.4894	2433.1450	1858.8294	1224.5706	780.2812	823.0269	1323.8569	2039.6367	2746.3300	3346.4017	(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													
	1845.5591	1460.0549	1248.8123	740.1432	335.7264	0.0000	0.0000	0.0000	0.0000	744.9103	1337.4549	1877.0686	(98)
Space heating												9589.7297	(98)
Space heating per m2											(98) / (4) =	48.4820	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	4929.0444	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1845.5591	1460.0549	1248.8123	740.1432	335.7264	0.0000	0.0000	0.0000	0.0000	744.9103	1337.4549	1877.0686	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	948.6026	750.4565	641.8796	380.4277	172.5607	0.0000	0.0000	0.0000	0.0000	382.8779	687.4411	964.7982	(211)
Water heating requirement													
	283.9322	224.6238	192.1250	113.8682	51.6502	0.0000	0.0000	0.0000	0.0000	114.6016	205.7623	288.7798	(215)
Water heating													
Water heating requirement													
	225.3751	198.6426	208.6096	186.9924	183.2375	163.7168	157.2203	172.5362	172.2367	193.9010	205.0459	219.9485	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	128.7122	113.4452	119.1374	106.7918	104.6474	93.4990	89.7889	98.5358	98.3648	110.7373	117.1022	125.6131	(219)
Water heating fuel used												1306.3750	(219)
Annual totals kWh/year													
Space heating fuel - main system												4929.0444	(211)
Space heating fuel - secondary												1475.3430	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												593.0893	(232)
Total delivered energy for all uses												8333.8518	(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	4929.0444	0.5190	2558.1740	(261)
Space heating - secondary	1475.3430	0.0190	28.0315	(263)
Water heating (other fuel)	1306.3750	0.5190	678.0086	(264)
Space and water heating			3264.2142	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	593.0893	0.5190	307.8133	(268)
Total CO2, kg/year			3587.5976	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.1400	(273)

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

DER		18.1400	ZC1
Total Floor Area	TFA	197.8000	
Assumed number of occupants	N	2.9991	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.0532	ZC2
CO2 emissions from cooking, equation (L16)		0.9655	ZC3
Total CO2 emissions		30.1587	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.1587	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9000 (1b)	x	2.5000 (2b)	=	247.2500 (1b) - (3b)	
First floor	98.9000 (1c)	x	2.7200 (2c)	=	269.0080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	197.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.2580	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0775 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.3275 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2784 (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	0.3549	0.3479	0.3410	0.3062	0.2992	0.2644	0.2644	0.2575	0.2784	0.2992	0.3132	0.3271	(22b)
Effective ac	0.5630	0.5605	0.5581	0.5469	0.5448	0.5350	0.5350	0.5331	0.5387	0.5448	0.5490	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.5200	1.0000	2.5200			(26)
TER Opening Type (Uw = 1.40)			35.6800	1.3258	47.3030			(27)
floor			98.9000	0.1300	12.8570			(28a)
External Wall	193.0400	38.2000	154.8400	0.1800	27.8712			(29a)
External Roof 1	98.9000		98.9000	0.1300	12.8570			(30)
Total net area of external elements Aum(A, m2)			390.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.4082			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.7044	(36)
Total fabric heat loss					(33) + (36) =		117.1126	(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	95.9121	95.4954	95.0871	93.1689	92.8100	91.1393	91.1393	90.8299	91.7828	92.8100	93.5360	94.2950	(38)
Heat transfer coeff	213.0247	212.6081	212.1997	210.2815	209.9226	208.2519	208.2519	207.9425	208.8954	209.9226	210.6486	211.4077	(39)
Average = Sum(39)m / 12 =												210.2798	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0770	1.0749	1.0728	1.0631	1.0613	1.0528	1.0528	1.0513	1.0561	1.0613	1.0650	1.0688	(40)
HLP (average)												1.0631	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9991	(42)
Average daily hot water use (litres/day)												105.4276	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.9704	111.7533	107.5362	103.3190	99.1019	94.8848	94.8848	99.1019	103.3190	107.5362	111.7533	115.9704	(44)
Energy conte	171.9807	150.4154	155.2152	135.3204	129.8431	112.0448	103.8259	119.1418	120.5647	140.5066	153.3739	166.5541	(45)
Energy content (annual)										Total = Sum(45)m =		1658.7867	(45)
Distribution loss (46)m = 0.15 x (45)m	25.7971	22.5623	23.2823	20.2981	19.4765	16.8067	15.5739	17.8713	18.0847	21.0760	23.0061	24.9831	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	226.8875	200.0086	210.1220	188.4560	184.7499	165.1804	158.7327	174.0486	173.7003	195.4133	206.5095	221.4609	(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													
	226.8875	200.0086	210.1220	188.4560	184.7499	165.1804	158.7327	174.0486	173.7003	195.4133	206.5095	221.4609	(64)
									Total per year (kWh/year) = Sum(64)m =			2305.2698	(64)
Heat gains from water heating, kWh/month													
	101.1090	89.6877	95.5345	87.5025	87.0983	79.7634	78.4476	83.5401	82.5963	90.6439	93.5053	99.3047	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	149.9528	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.5832	29.8283	24.2580	18.3649	13.7279	11.5897	12.5231	16.2780	21.8483	27.7414	32.3783	34.5166	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	368.9497	372.7782	363.1304	342.5914	316.6645	292.2970	276.0179	272.1894	281.8372	302.3762	328.3031	352.6706	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	37.9953	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	-119.9623	(71)
Water heating gains (Table 5)													
	135.8992	133.4639	128.4066	121.5313	117.0676	110.7825	105.4403	112.2850	114.7170	121.8331	129.8685	133.4740	(72)
Total internal gains													
	609.4179	607.0562	586.7808	553.4734	518.4459	485.6550	464.9671	471.7383	489.3883	522.9366	561.5357	591.6471	(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	15.4800	10.6334	0.6300	0.7000	0.7700	50.3054	(74)
East	2.2300	19.6403	0.6300	0.7000	0.7700	13.3852	(76)
South	12.4700	46.7521	0.6300	0.7000	0.7700	178.1718	(78)
West	5.5000	19.6403	0.6300	0.7000	0.7700	33.0128	(80)

Solar gains	274.8752	478.7000	684.5355	900.5004	1058.4137	1073.1939	1025.2977	903.7014	758.5422	536.8702	331.1054	234.0493	(83)
Total gains	884.2931	1085.7562	1271.3163	1453.9737	1576.8596	1558.8489	1490.2649	1375.4397	1247.9305	1059.8068	892.6411	825.6964	(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	64.4813	64.6077	64.7320	65.3225	65.4342	65.9591	65.9591	66.0572	65.7559	65.4342	65.2086	64.9745	
alpha	5.2988	5.3072	5.3155	5.3548	5.3623	5.3973	5.3973	5.4038	5.3837	5.3623	5.3472	5.3316	
util living area													
	0.9995	0.9985	0.9946	0.9780	0.9177	0.7709	0.5969	0.6625	0.8973	0.9892	0.9988	0.9997	(86)
MIT	19.7134	19.8741	20.1272	20.4585	20.7562	20.9366	20.9871	20.9781	20.8446	20.4523	20.0179	19.6862	(87)
Th 2	20.0197	20.0214	20.0231	20.0311	20.0326	20.0395	20.0395	20.0408	20.0369	20.0326	20.0296	20.0264	(88)
util rest of house													
	0.9994	0.9979	0.9926	0.9689	0.8831	0.6859	0.4758	0.5404	0.8407	0.9834	0.9983	0.9996	(89)
MIT 2	18.2824	18.5186	18.8891	19.3726	19.7804	19.9946	20.0344	20.0310	19.9017	19.3696	18.7352	18.2473	(90)
Living area fraction										fLA = Living area / (4) =		0.1481	(91)
MIT	18.4943	18.7193	19.0725	19.5334	19.9249	20.1341	20.1755	20.1713	20.0413	19.5300	18.9251	18.4604	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4943	18.7193	19.0725	19.5334	19.9249	20.1341	20.1755	20.1713	20.0413	19.5300	18.9251	18.4604	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9968	0.9897	0.9627	0.8784	0.6952	0.4937	0.5581	0.8410	0.9790	0.9973	0.9993	(94)
Useful gains	883.3656	1082.2750	1258.2522	1399.7062	1385.1302	1083.6578	735.6930	767.5659	1049.5512	1037.5781	890.2674	825.0949	(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													
	3023.7390	2938.0987	2667.8758	2236.0052	1726.5940	1152.4814	744.6047	784.2084	1241.1153	1874.6014	2490.9406	3014.7489	(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													
	1592.4378	1247.1135	1048.7600	602.1353	254.0491	0.0000	0.0000	0.0000	0.0000	622.7454	1152.4847	1629.1026	(98)
Space heating												8148.8284	(98)
Space heating per m2											(98) / (4) =	41.1973	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	8715.3245	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1592.4378	1247.1135	1048.7600	602.1353	254.0491	0.0000	0.0000	0.0000	0.0000	622.7454	1152.4847	1629.1026	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1703.1420	1333.8113	1121.6684	643.9950	271.7103	0.0000	0.0000	0.0000	0.0000	666.0378	1232.6040	1742.3558	(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													
	226.8875	200.0086	210.1220	188.4560	184.7499	165.1804	158.7327	174.0486	173.7003	195.4133	206.5095	221.4609	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.0116	88.8534	88.5189	87.6970	85.6639	79.8000	79.8000	79.8000	79.8000	87.6916	88.6929	89.0707	(217)
Fuel for water heating, kWh/month													
	254.8966	225.0997	237.3753	214.8945	215.6684	206.9929	198.9132	218.1060	217.6696	222.8415	232.8367	248.6348	(219)
Water heating fuel used												2693.9292	(219)
Annual totals kWh/year													
Space heating fuel - main system												8715.3245	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												593.0893	(232)
Total delivered energy for all uses												12077.3430	(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	8715.3245	0.2160	1882.5101	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2693.9292	0.2160	581.8887	(264)
Space and water heating			2464.3988	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	593.0893	0.5190	307.8133	(268)
Total CO2, kg/m2/year			2811.1371	(272)
Emissions per m2 for space and water heating			12.4590	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.5562	(272b)
Emissions per m2 for pumps and fans			0.1968	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.4590 * 1.55) + 1.5562 + 0.1968, rounded to 2 d.p.			21.0600	(273)

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

Property Reference	4453-19	**Issued on Date**	30/07/2021
Assessment Reference	001	**Prop Type Ref**	
Property	19, Sibford Ferris		

SAP Rating	76 C	**DER**	20.34	**TER**	23.15
Environmental	80 C	**% DER<TER**	12.15		
CO_2 Emissions (t/year)	3.34	**DFEE**	59.41	**TFEE**	60.03
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.04		

Assessor Details	Mr. Harry Davey, energytest, Tel: 01892 315466, hdavey@energy-test.co.uk	**Assessor ID**	R434-0001
Client			

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

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

Detached House, total floor area 200 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.15 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.34 kgCO□/m²OK
-------------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)60.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)59.4 kWh/m²/yrOK
-------------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.25 (max. 0.30)        0.25 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.10 (max. 0.25)        0.10 (max. 0.70)          OK
Roof            0.13 (max. 0.20)        0.13 (max. 0.35)          OK
Openings        1.40 (max. 2.00)        1.40 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         5.00 (design value)
Maximum                                 10.0                                            OK
-------------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Heat pump with radiators or underfloor - Electric
Air-to-water heat pump



Secondary heating system:               Room heaters - Wood Logs

Closed room heater
Efficiency: 65%
Minimum: 65%                                    OK
-------------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.80 kWh/day
Permitted by DBSCG 2.56                         OK
Primary pipework insulated:             Yes                                             OK
-------------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control               OK


Hot water controls:                     Cylinderstat                                    OK
                                        Independent timer for DHW                       OK

-------------------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                             OK
-------------------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Not significant                                 OK
Based on:
Overshading:                            Average
Windows facing North East:              4.50 m², No overhang
Windows facing South East:              15.26 m², No overhang
Windows facing North West:              12.06 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Light-coloured curtain or roller blind, closed 100% of daylight hours
-------------------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Floor U-value                           0.10 W/m²K
Secondary heating (wood logs)
Secondary heating fuel:                 wood logs



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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	100.0200 (1b)	x	2.7800 (2b)	=	278.0556	(1b) - (3b)
First floor	100.0200 (1c)	x	2.7000 (2c)	=	270.0540	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	200.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	548.1096	(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	+	1	=	1 * 20 =	20.0000	(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) =	80.0000 / (5) =	0.1460	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3960	(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) =	0.3663	(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	0.4670	0.4578	0.4487	0.4029	0.3937	0.3479	0.3479	0.3388	0.3663	0.3937	0.4120	0.4304	(22b)
Effective ac	0.6090	0.6048	0.6007	0.5812	0.5775	0.5605	0.5605	0.5574	0.5671	0.5775	0.5849	0.5926	(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	
Door			5.6100	1.4000	7.8540			(26a)
Window (Uw = 1.40)			31.8200	1.3258	42.1856			(27)
floor			100.0200	0.1000	10.0020			(28a)
External Wall	244.4100	37.4300	206.9800	0.2500	51.7450			(29a)
External Roof 1	100.0200		100.0200	0.1300	13.0026			(30)
Total net area of external elements Aum(A, m2)			444.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		124.7892			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	26.9248	(36)
Total fabric heat loss (33) + (36) =	151.7140	(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	110.1600	109.3942	108.6435	105.1177	104.4580	101.3871	101.3871	100.8184	102.5700	104.4580	105.7925	107.1877	(38)
Heat transfer coeff	261.8740	261.1082	260.3575	256.8317	256.1720	253.1011	253.1011	252.5325	254.2840	256.1720	257.5065	258.9017	(39)
Average = Sum(39)m / 12 =												256.8285	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3091	1.3053	1.3015	1.2839	1.2806	1.2653	1.2653	1.2624	1.2712	1.2806	1.2873	1.2942	(40)
HLP (average)												1.2839	(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	3.0020 (42)
Average daily hot water use (litres/day)	105.4968 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	116.0465	111.8266	107.6068	103.3869	99.1670	94.9472	94.9472	99.1670	103.3869	107.6068	111.8266	116.0465	(44)
Energy conte	172.0936	150.5142	155.3172	135.4093	129.9284	112.1183	103.8941	119.2200	120.6439	140.5988	153.4746	166.6635	(45)
Energy content (annual)											Total = Sum(45)m =	1659.8761	(45)
Distribution loss (46)m = 0.15 x (45)m	25.8140	22.5771	23.2976	20.3114	19.4893	16.8178	15.5841	17.8830	18.0966	21.0898	23.0212	24.9995	(46)

Water storage loss:	
Store volume	250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8000 (48)
Temperature factor from Table 2b	0.5400 (49)

Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage													
	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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													
	225.4880	198.7414	208.7116	187.0813	183.3228	163.7903	157.2885	172.6144	172.3159	193.9932	205.1466	220.0579	(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													
	225.4880	198.7414	208.7116	187.0813	183.3228	163.7903	157.2885	172.6144	172.3159	193.9932	205.1466	220.0579	(64)
									Total per year (kWh/year) = Sum(64)m =			2288.5521	(64)
Heat gains from water heating, kWh/month													
	99.9367	88.6277	94.3585	86.3612	85.9167	78.6170	77.2603	82.3562	81.4517	89.4646	92.3679	98.1311	(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	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	34.5541	30.6906	24.9593	18.8958	14.1248	11.9248	12.8851	16.7486	22.4799	28.5434	33.3144	35.5144	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.0833	374.9340	365.2304	344.5726	318.4958	293.9873	277.6142	273.7635	283.4671	304.1249	330.2017	354.7102	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	(71)
Water heating gains (Table 5)													
	134.3235	131.8865	126.8259	119.9461	115.4795	109.1902	103.8445	110.6938	113.1274	120.2482	128.2888	131.8967	(72)
Total internal gains													
	610.9905	608.5407	588.0452	554.4441	519.1297	486.1319	465.3734	472.2354	490.1039	523.9460	562.8344	593.1509	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.5000	11.2829	0.6300	0.7000	0.7700	15.5170	(75)
Southeast	15.2600	36.7938	0.6300	0.7000	0.7700	171.5937	(77)
Northwest	12.0600	11.2829	0.6300	0.7000	0.7700	41.5855	(81)

Solar gains	228.6961	408.5212	609.3366	839.4423	1017.3225	1043.8694	992.2924	854.4025	688.2061	465.0867	277.3793	193.4812	(83)
Total gains	839.6866	1017.0619	1197.3818	1393.8864	1536.4522	1530.0013	1457.6658	1326.6379	1178.3101	989.0328	840.2137	786.6320	(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	53.0471	53.2027	53.3561	54.0886	54.2279	54.8858	54.8858	55.0094	54.6305	54.2279	53.9469	53.6561	
alpha	4.5365	4.5468	4.5571	4.6059	4.6152	4.6591	4.6591	4.6673	4.6420	4.6152	4.5965	4.5771	
util living area													
	0.9995	0.9988	0.9963	0.9861	0.9487	0.8459	0.6982	0.7649	0.9421	0.9935	0.9990	0.9997	(86)
MIT	19.7309	19.8487	20.0557	20.3454	20.6232	20.8295	20.9087	20.8912	20.7196	20.3629	19.9998	19.7183	(87)
Th 2	19.8337	19.8367	19.8396	19.8535	19.8561	19.8682	19.8682	19.8704	19.8635	19.8561	19.8508	19.8453	(88)
util rest of house													
	0.9994	0.9984	0.9949	0.9797	0.9221	0.7624	0.5492	0.6248	0.8994	0.9896	0.9986	0.9996	(89)
MIT 2	18.1280	18.3026	18.6073	19.0385	19.4312	19.6986	19.7695	19.7613	19.5732	19.0686	18.5346	18.1182	(90)
Living area fraction										fLA = Living area / (4) =		0.1461	(91)
MIT	18.3622	18.5285	18.8190	19.2295	19.6054	19.8639	19.9359	19.9264	19.7407	19.2578	18.7487	18.3520	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3622	18.5285	18.8190	19.2295	19.6054	19.8639	19.9359	19.9264	19.7407	19.2578	18.7487	18.3520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9976	0.9929	0.9748	0.9144	0.7620	0.5592	0.6329	0.8931	0.9865	0.9979	0.9993	(94)
Useful gains	838.8935	1014.6160	1188.9277	1358.8004	1404.9002	1165.8822	815.0968	839.6610	1052.3378	975.7041	838.4693	786.0918	(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													
	3682.5265	3558.5202	3207.3384	2652.9343	2025.1369	1332.2899	844.3319	890.5343	1434.3457	2217.8740	2999.6059	3663.9808	(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													
	2115.6629	1709.5036	1501.6975	931.7764	461.4561	0.0000	0.0000	0.0000	0.0000	924.1744	1556.0183	2141.1494	(98)
Space heating												11341.4388	(98)
Space heating per m2											(98) / (4) =	56.6959	(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)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												5829.4089	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2115.6629	1709.5036	1501.6975	931.7764	461.4561	0.0000	0.0000	0.0000	0.0000	924.1744	1556.0183	2141.1494	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	1087.4338	878.6712	771.8605	478.9256	237.1848	0.0000	0.0000	0.0000	0.0000	475.0182	799.7810	1100.5337	(211)
Water heating requirement													
	325.4866	263.0006	231.0304	143.3502	70.9933	0.0000	0.0000	0.0000	0.0000	142.1807	239.3874	329.4076	(215)
Water heating													
Water heating requirement													
	225.4880	198.7414	208.7116	187.0813	183.3228	163.7903	157.2885	172.6144	172.3159	193.9932	205.1466	220.0579	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	128.7767	113.5017	119.1956	106.8425	104.6961	93.5410	89.8278	98.5805	98.4100	110.7900	117.1597	125.6756	(219)
Water heating fuel used												1306.9972	(219)
Annual totals kWh/year													
Space heating fuel - main system												5829.4089	(211)
Space heating fuel - secondary												1744.8367	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												610.2359	(232)
Total delivered energy for all uses												9521.4786	(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	5829.4089	0.5190	3025.4632	(261)
Space heating - secondary	1744.8367	0.0190	33.1519	(263)
Water heating (other fuel)	1306.9972	0.5190	678.3315	(264)
Space and water heating			3736.9466	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	610.2359	0.5190	316.7124	(268)
Total CO2, kg/year			4069.2290	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.3400	(273)

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

DER		20.3400	ZC1
Total Floor Area	TFA	200.0400	
Assumed number of occupants	N	3.0020	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		10.9926	ZC2
CO2 emissions from cooking, equation (L16)		0.9550	ZC3
Total CO2 emissions		32.2877	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2877	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	100.0200 (1b)	x	2.7800 (2b)	=	278.0556	(1b) - (3b)
First floor	100.0200 (1c)	x	2.7000 (2c)	=	270.0540	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	200.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	548.1096	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0730	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3230	(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) =	0.2988	(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	0.3809	0.3734	0.3660	0.3286	0.3212	0.2838	0.2838	0.2763	0.2988	0.3212	0.3361	0.3510	(22b)
Effective ac	0.5725	0.5697	0.5670	0.5540	0.5516	0.5403	0.5403	0.5382	0.5446	0.5516	0.5565	0.5616	(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			5.6100	1.2000	6.7320			(26a)
TER Opening Type (Uw = 1.40)			31.8200	1.3258	42.1856			(27)
floor			100.0200	0.1300	13.0026			(28a)
External Wall	244.4100	37.4300	206.9800	0.1800	37.2564			(29a)
External Roof 1	100.0200		100.0200	0.1300	13.0026			(30)
Total net area of external elements Aum(A, m2)			444.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.1792			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.4598	(36)
Total fabric heat loss					(33) + (36) =		128.6390	(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	103.5601	103.0506	102.5511	100.2052	99.7663	97.7231	97.7231	97.3447	98.5101	99.7663	100.6542	101.5825	(38)
Heat transfer coeff	232.1991	231.6896	231.1901	228.8442	228.4053	226.3621	226.3621	225.9837	227.1491	228.4053	229.2932	230.2215	(39)
Average = Sum(39)m / 12 =												228.8421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1608	1.1582	1.1557	1.1440	1.1418	1.1316	1.1316	1.1297	1.1355	1.1418	1.1462	1.1509	(40)
HLP (average)												1.1440	(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												3.0020	(42)
Average daily hot water use (litres/day)												105.4968	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	116.0465	111.8266	107.6068	103.3869	99.1670	94.9472	94.9472	99.1670	103.3869	107.6068	111.8266	116.0465	(44)
Energy conte	172.0936	150.5142	155.3172	135.4093	129.9284	112.1183	103.8941	119.2200	120.6439	140.5988	153.4746	166.6635	(45)
Energy content (annual)										Total = Sum(45)m =		1659.8761	(45)
Distribution loss (46)m = 0.15 x (45)m	25.8140	22.5771	23.2976	20.3114	19.4893	16.8178	15.5841	17.8830	18.0966	21.0898	23.0212	24.9995	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	227.0004	200.1074	210.2240	188.5449	184.8352	165.2540	158.8009	174.1268	173.7795	195.5056	206.6102	221.5703	(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													
	227.0004	200.1074	210.2240	188.5449	184.8352	165.2540	158.8009	174.1268	173.7795	195.5056	206.6102	221.5703	(64)
								Total per year (kWh/year) = Sum(64)m =				2306.3592	(64)
Heat gains from water heating, kWh/month													
	101.1466	89.7206	95.5684	87.5321	87.1266	79.7878	78.4702	83.5661	82.6226	90.6745	93.5388	99.3410	(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	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	150.0986	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	34.5541	30.6906	24.9593	18.8958	14.1248	11.9248	12.8851	16.7486	22.4799	28.5434	33.3144	35.5144	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.0833	374.9340	365.2304	344.5726	318.4958	293.9873	277.6142	273.7635	283.4671	304.1249	330.2017	354.7102	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	38.0099	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	-120.0789	(71)
Water heating gains (Table 5)													
	135.9497	133.5127	128.4521	121.5723	117.1057	110.8164	105.4707	112.3200	114.7536	121.8744	129.9150	133.5229	(72)
Total internal gains													
	612.6167	610.1670	589.6714	556.0703	520.7559	487.7581	466.9996	473.8617	491.7302	525.5723	564.4606	594.7771	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.5000	11.2829	0.6300	0.7000	0.7700	15.5170	(75)
Southeast	15.2600	36.7938	0.6300	0.7000	0.7700	171.5937	(77)
Northwest	12.0600	11.2829	0.6300	0.7000	0.7700	41.5855	(81)

Solar gains	228.6961	408.5212	609.3366	839.4423	1017.3225	1043.8694	992.2924	854.4025	688.2061	465.0867	277.3793	193.4812	(83)
Total gains	841.3128	1018.6882	1199.0081	1395.5126	1538.0784	1531.6276	1459.2920	1328.2641	1179.9363	990.6590	841.8400	788.2583	(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	59.8265	59.9581	60.0876	60.7036	60.8202	61.3692	61.3692	61.4720	61.1566	60.8202	60.5847	60.3404	
alpha	4.9884	4.9972	5.0058	5.0469	5.0547	5.0913	5.0913	5.0981	5.0771	5.0547	5.0390	5.0227	
util living area													
	0.9996	0.9989	0.9963	0.9841	0.9371	0.8117	0.6482	0.7198	0.9289	0.9930	0.9991	0.9997	(86)
MIT	19.5771	19.7284	19.9880	20.3440	20.6790	20.9032	20.9764	20.9607	20.7781	20.3456	19.8978	19.5544	(87)
Th 2	19.9515	19.9536	19.9556	19.9651	19.9668	19.9751	19.9751	19.9767	19.9719	19.9668	19.9633	19.9595	(88)
util rest of house													
	0.9995	0.9985	0.9948	0.9772	0.9075	0.7273	0.5141	0.5886	0.8821	0.9889	0.9987	0.9996	(89)
MIT 2	18.0345	18.2572	18.6381	19.1607	19.6278	19.9042	19.9656	19.9584	19.7700	19.1682	18.5122	18.0068	(90)
Living area fraction									fLA = Living area / (4) =			0.1461	(91)
MIT	18.2599	18.4722	18.8353	19.3336	19.7814	20.0502	20.1133	20.1049	19.9173	19.3402	18.7147	18.2329	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2599	18.4722	18.8353	19.3336	19.7814	20.0502	20.1133	20.1049	19.9173	19.3402	18.7147	18.2329	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9976	0.9924	0.9712	0.9008	0.7344	0.5334	0.6068	0.8789	0.9852	0.9979	0.9994	(94)
Useful gains	840.5673	1016.2204	1189.8747	1355.3876	1385.5186	1124.7586	778.4058	805.9307	1037.0350	975.9945	840.1010	787.7591	(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													
	3241.4678	3144.5384	2851.8024	2387.6695	1845.8314	1233.7133	795.2824	837.2398	1321.3867	1996.3142	2663.1727	3230.6818	(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													
	1786.2700	1430.2297	1236.4742	743.2430	342.4727	0.0000	0.0000	0.0000	0.0000	759.1178	1312.6116	1817.5345	(98)
Space heating												9427.9535	(98)
Space heating per m2											(98) / (4) =	47.1303	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												10083.3727	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1786.2700	1430.2297	1236.4742	743.2430	342.4727	0.0000	0.0000	0.0000	0.0000	759.1178	1312.6116	1817.5345	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1910.4492	1529.6574	1322.4323	794.9123	366.2810	0.0000	0.0000	0.0000	0.0000	811.8907	1403.8627	1943.8872	(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													
	227.0004	200.1074	210.2240	188.5449	184.8352	165.2540	158.8009	174.1268	173.7795	195.5056	206.6102	221.5703	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.1522	89.0347	88.7704	88.1094	86.4374	79.8000	79.8000	79.8000	79.8000	88.0812	88.8793	89.2004	(217)
Fuel for water heating, kWh/month													
	254.6213	224.7522	236.8177	213.9894	213.8371	207.0852	198.9986	218.2040	217.7688	221.9606	232.4617	248.3962	(219)
Water heating fuel used												2688.8927	(219)
Annual totals kWh/year													
Space heating fuel - main system												10083.3727	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												610.2359	(232)
Total delivered energy for all uses												13457.5013	(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	10083.3727	0.2160	2178.0085	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2688.8927	0.2160	580.8008	(264)
Space and water heating			2758.8093	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	610.2359	0.5190	316.7124	(268)
Total CO2, kg/m2/year			3114.4467	(272)
Emissions per m2 for space and water heating			13.7913	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.5832	(272b)
Emissions per m2 for pumps and fans			0.1946	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7913 * 1.55) + 1.5832 + 0.1946, rounded to 2 d.p.			23.1500	(273)