Energy Assessment

Land to the East of London School of Theology, Green Lane, Northwood (Trinity House)

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Executive Summary

This Energy Assessment has been prepared in response to Condition 17 a) and Condition 23 relating to the consent granted for the erection of a residential building comprising 15 flats with associated parking, cycle storage, motorcycle parking, disabled parking and bin storage following the demolition of the existing residential block and a pair of semi-detached houses on land to the east of London School of Theology, Green Lane, Northwood.

The methodology used has been based upon the policy in the London Plan (and provided in 'Energy Assessment Guidance' published by the Mayor of London) and uses the carbon factors for gas and electricity proposed for SAP 10.

The fabric standards of the building exceed the requirements of the Building Regulations.

In order to demonstrate the energy efficiency of the building a set of SAP calculations have been prepared for the 'Be Lean' scenario based on the use of gas boilers to each apartment. This is not the proposed strategy but purely demonstrates the reduction from the 'Be Lean' condition.

The SAP Worksheets for this option are attached as Appendix 1 and the 'Be Lean' GLA spreadsheet based on the SAP 10 carbon factors is attached as Appendix 2.

It is proposed to provide space heating and hot water to the apartments using a communal heat network which will be heated using air source heat pumps. SAP calculations have been prepared for the 'Be Clean' scenario based on the use of ASHPs.

The SAP Worksheets for the proposed option are attached as Appendix 3 and the 'Be Clean' GLA spreadsheet based on the SAP 10 carbon factors is attached as Appendix 4.

In order to maximise the reduction in emissions it is also proposed to install a photovoltaic array of 40 x 350W photovoltaic panels (14.0 kW). The panels will be installed on the flat roof section of the main roof and inclined at circa 20 degrees, orientated towards due south. Access to the flat roof for maintenance and periodic cleaning of the panels will be gained through the mechanical smoke vent at second floor level.

A Roof Plan showing the indicative layout of the panels is attached as Appendix 5.

The heating solution to the building proposes an all electric installation and therefore there are no on site carbon emissions or nitrogen oxide emissions. The strategy therefore complies with the requirements of Condition 17 a).

The reductions in emissions can be summarised as follows:

	Total Emissions	% Reduction
	T CO_2 per year	
Be Lean		
Baseline (Building Regulations TER) – based on gas	26.455	
Be Lean - after energy efficiency (DER) – based on gas	23.089	**12.72%**
Be Clean		
Emissions – after heat pumps (Be Clean)	10.182	**61.51%**
Be Green		
Emissions – after renewable technologies (Be Green)	7.202	**72.78%**

The residual emissions are 7.202 tonnes and therefore, using the carbon offset charge the payment should be **£20,526** (7.202 x £2,850).

1.0 Introduction

This report has been commissioned by Westcombe Homes and provides an Energy Assessment in response to Condition 17 a) and Condition 23 relating the consent granted for the erection of a residential building comprising 15 flats with associated parking, cycle storage, motorcycle parking, disabled parking and bin storage following the demolition of the existing residential block and a pair of semi-detached houses on land to the east of London School of Theology, Green Lane, Northwood.

The Conditions say;

17. *No construction works shall be undertaken until a clear and effective low emission strategy (LES) have been submitted to and approved in writing by the Local Planning Authority. The strategy shall include, but not be restricted to:*
a) Be clean by design as per the London Sustainable Design and Construction Supplementary Planning Guidance,

23. *Prior to commencement of development, an Energy Assessment for the 15 units hereby approved, shall be submitted to, and approved in writing by, the Local Planning Authority. The assessment shall set out the annual baseline regulated energy demand (kwhr) as per 2013 Building Regulations (or subsequent amendments) and associated carbon emissions (kgCO_2 and tCO_2). The assessment shall then set out the measures and technology required to a achieve a 100% reduction (zero carbon) in the CO_2 associated with the baseline regulated energy demand; these measures must be sufficiently evidenced with corresponding details and specifications including the location of low and zero carbon technology (i.e. roof plans showing the inclusion of PV panels). The updated Energy Assessment must clearly set out any shortfall (tCO_2) of the zero carbon standard. The development must proceed in accordance with the approved updated Energy Assessment.*

The report describes the methodology used in assessing the development and the initiatives proposed.

The building has been designed and will be constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the building that has the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once a cost-effective structure has been designed, low-carbon and renewable technologies have been considered for installation to provide heat and/or electricity.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Assessment Methodology

The carbon dioxide emissions from the building have been established using agreed building specifications and detailed working drawings. SAP calculations have been prepared for the apartments based on different scenarios. SAP Worksheets are attached as Appendices 2 and 4 for the 'Be Lean' and 'Be Clean' scenarios respectively.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from the emerging Building Regulation Approved Document L - 2021.

	kg CO_2/kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.233

3.0 Proposal

The proposal is for the construction of 15 apartments. The accommodation schedule in detail is;

Unit Type	Number	Area	Total Area
		m^2	m^2
2-Bedroom apartment	1	95.6	95.6
2-Bedroom apartment	1	96.3	96.3
2-Bedroom apartment	1	104.8	104.8
2-Bedroom apartment	1	105.4	105.4
2-Bedroom apartment	1	114.8	114.8
2-Bedroom apartment	1	115.2	115.2
2-Bedroom apartment	1	121.0	121.0
2-Bedroom apartment	1	131.2	131.2
2-Bedroom apartment	1	135.3	135.3
2-Bedroom apartment	1	142.8	142.8
2-Bedroom apartment	1	144.4	144.4
2-Bedroom apartment	1	146.2	146.2
3-Bedroom apartment	1	147.5	147.5
2-Bedroom apartment	1	150.8	150.8
3-Bedroom apartment	1	150.9	150.9
Total	**15**		**1,902.2**

4.0 Energy Efficiency

4.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L - 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. variable speed motors).

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The position of the building within the site is in context with surrounding development and the shape of the site.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the apartments heating requirements.

Ground floors will be insulated with 120mm Kingspan K103 PIR insulation.

The external walls will be built using either a traditional cavity wall construction with a 100mm cavity partially filled with 90mm of Kingspan K106 insulation or timber frame construction with a 50mm Low e cavity and 100mm Kingspan K112 insulation between studs and 32.5mm of Kingspan K118 insulated plasterboard internally.

All roofs will be insulated with 150mm Kingspan K7 insulation between rafters with 52.5mm of Kingspan K118 insulation beneath.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

The following U-values have been calculated for each element:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m²K	W/m²K	
Ground Floor	**0.20**	**0.13**	**35%**
External Walls (masonry)	**0.30**	**0.17**	**43%**
External Walls (timber-frame)	**0.30**	**0.17**	**43%**
Roof	**0.20**	**0.13**	**35%**
Windows	**2.00**	**1.40**	**30%**
Entrance Doors		**1.40**	

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 10 m^3 of air per hour per m^2 of envelope area, at 50Pa.

It is proposed to achieve a 50% improvement over Building Regulations and the building will target a permeability of 5.0 $m^3/hr/m^2$.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

The SAP calculations have been based on the use of the Concrete Block Association calculated Ψ values and 2D thermal models and will enable the building to achieve the higher energy efficiency requirements of the Building Regulations.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2006 to address the possibility of overheating and poor air quality.

Ventilation to the apartments will be provided by a System 1, intermittent extract fan installation.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings.

The homes will exceed this and all light fittings will be of a dedicated energy efficient type.

External lighting will be fitted with time controls and light sensors to ensure illumination is restricted to required times. External lighting will be limited to a maximum fitting output of 150w.

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a combination boiler installed to each apartment but the assessment considers other options for providing space heating and hot water.

4.2 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)

The GLA Energy Assessment Guidance requires the energy efficiency of a building (Be Lean) to be expressed using a gas heating system as a baseline.

The SAP Worksheets are attached as Appendix 1 and the energy demand calculated has been input into the spreadsheet attached as Appendix 2 to provide the emissions based on the SAP 10 carbon factors.

Summary

The maximum allowable carbon dioxide emissions from the site (TER) are assessed as **26,455 kg CO_2 per year**, with the actual carbon dioxide emissions (DER) assessed as **23,089 kg CO_2 per year.**

The reduction in emissions from energy efficiency for the 'Be Lean' scenario and using the SAP 10 carbon factors is **3,366 kg CO_2 per year**, which equates to a reduction of;

- **12.72%**

The GLA Guidance requires a minimum reduction of 10% at the Be Lean stage and therefore, the proposed construction complies.

4.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Green Lane to be 5.3 m/s at 10m above ground level and 6.1 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

Consequently CHP can demonstrate significant CO_2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

For a CHP plant to be economic it needs to operate for as much of the time as possible (usually deemed to be in excess of 14 hours per day) and therefore the size of the unit are usually based upon the hot water load of the building (s) with additional boilers meeting the peak space heating demand.

There is insufficient baseload to justify a CHP unit and therefore this technology is not proposed.

However, the building could be served by a community heating system and this is considered below.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12º C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

There is insufficient external area to install a shallow, horizontal collection system and in order to use ground source heat pumps the collection system would need to include a number of boreholes.

These would be cost prohibitive and the installation of ground source heat pumps is not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

In apartment buildings servicing apartments below the top-floor can be problematic for solar thermal panels. The total hot water demand of the three top-floor apartments is 4,621 kWh per year (based on the gas system) and assuming panels would reduce demand by 50% the reduction in CO_2 emissions would be 485 kg CO_2 per year. When combined with the energy efficiency measures incorporated into the scheme this equates to a total reduction of 14.56%.

Solar hot water panels could be used to reduce emissions but additional technologies would be required to achieve the policy target and the use of solar hot water heating panels would require the installation of hot water cylinders in each apartment.

Solar hot water heating panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

The design of the pitched roof is complicated and is not suited to the installation of panels. However, the building contains a flat roof element and could accommodate a number of photovoltaic panels, which would not impact on the aesthetic of the development. The Roof Plan attached as Appendix 5 demonstrates a total of 40 panels could be installed. These would be installed on racks and gently inclined at circa 20 degrees towards due south and assuming the installation of 350W panels the total reduction in emissions from the array would be **2,980 kg CO_2 per year**.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

The use of a communal system is appropriate and it is proposed to install an air source heat pump into all residential units. Each apartment will have its own indoor unit, which will be connected to a common outdoor unit.

4.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Clean)

Using the methodology set out in the Mayor of London's 'Energy Assessment Guidance', the carbon emissions have been calculated using the new carbon factors proposed as part of the new Part L of the Building Regulations, which will be published in 2022 but using the existing SAP methodology (2012).

It is proposed to install an air source heat pump system into each apartment. Each apartment will have its own indoor unit, which will be connected a common outdoor unit.

The SAP Worksheets for the proposed solution are attached as Appendix 3 and the energy demand calculated has been input into the spreadsheet attached as Appendix 4 to provide the emissions based on the SAP 10 carbon factors.

Summary

The actual carbon dioxide emissions (DER) are assessed as **10,182 kg CO_2 per year**, which equates to a reduction of;

- **61.51%**

4.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

Be Lean

A baseline calculation has been prepared using 2013 Building Regulations and the SAP 10 carbon factors. Using the current Regulations and based upon a gas heating system for the apartments the total site CO_2 emissions are calculated as **26,455 kg CO_2 per year** (TER) and **23,089 kg CO_2 per year** (DER)**.**

This equates to a reduction of **3,366 kg CO_2 per year** or **12.72%** of the total TER emissions. The reductions from energy efficiency is therefore compliant with the GLA energy planning guidance. The SAP Worksheets for the apartments are attached as Appendix 1 and the SAP 10 'Be Lean' spreadsheet is attached as Appendix 2.

Be Clean

A further set of calculations has been prepared for the proposed energy strategy. This proposes the installation of a communal heating system using air source heat pumps providing space heating and hot water to all apartments. These calculations have been converted to SAP 10 emissions and the 'Be Clean' spreadsheet is attached as Appendix 4. The SAP Worksheets for the apartments and based on the proposed strategy (based on Part L – 2013) are attached as Appendix 3.

The actual carbon dioxide emissions (DER) are assessed as **10,182 kg CO_2 per year.**

The reduction in emissions using from energy efficiency and heat pumps and using the SAP 10 carbon factors is **16,273 kg CO_2 per year**, which equates to **61.51%.**

Be Green

In addition, it is proposed to install a photovoltaic array of 14.0 kW on the roof of the building. The array will be comprised of 40 x 350W panels, which will be installed on racks and gently inclined at circa 20 degrees towards due south. The panels will reduce emissions by a further **2,980 kg CO_2 per year** and a Roof Plan showing the indicative location of the panels is attached as Appendix 5.

Summary

The total reduction in emissions from energy efficiency, low-carbon and renewable technologies are calculated as; 19,253 kg CO_2 per year, which equates to a reduction of 72.78% (% of TER).

The residual emissions are **7.202 tonnes**, which requires a carbon offset payment of **£20,526** (based on the carbon offset payment of £2,850 per tonne).

Appendix 1 – SAP Worksheets for the units using Gas Baseline

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-01	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT LGF
Property	Plot 1, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.27	**TER**	15.40
Environmental	87 B	**% DER<TER**	7.31		
CO_2 Emissions (t/year)	1.71	**DFEE**	44.30	**TFEE**	51.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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)	
Basement floor	147.5400 (1a)	x	2.5000 (2a)	=	368.8500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.8500	(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) =	0.1356	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3856	(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) =	0.3277	(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	0.4178	0.4097	0.4015	0.3605	0.3523	0.3113	0.3113	0.3031	0.3277	0.3523	0.3687	0.3851	(22b)
Effective ac	0.5873	0.5839	0.5806	0.5650	0.5621	0.5485	0.5485	0.5459	0.5537	0.5621	0.5680	0.5741	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			19.6200	1.3258	26.0114			(27)
GF			147.5400	0.1300	19.1802	75.0000	11065.5000	(28a)
Main Type 3	95.9700	19.6200	76.3500	0.1700	12.9795	110.0000	8398.5000	(29a)
Corridor	4.2300	1.9500	2.2800	0.2257	0.5147	110.0000	250.8000	(29a)
Total net area of external elements Aum(A, m2)			247.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.0257			(33)
Party Wall 1			22.3500	0.0000	0.0000	20.0000	447.0000	(32)
Party Ceilings 1			147.5400			30.0000	4426.2000	(32b)
Internal Wall 1			245.1000			75.0000	18382.5000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		42970.5000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							291.2464	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							12.6347	(36)
Total fabric heat loss					(33) + (36) =		73.6605	(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	71.4862	71.0736	70.6691	68.7695	68.4140	66.7595	66.7595	66.4531	67.3968	68.4140	69.1331	69.8848	(38)
Heat transfer coeff	145.1467	144.7341	144.3296	142.4299	142.0745	140.4199	140.4199	140.1135	141.0573	142.0745	142.7935	143.5452	(39)
Average = Sum(39)m / 12 =												142.4282	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9838	0.9810	0.9782	0.9654	0.9630	0.9517	0.9517	0.9497	0.9561	0.9630	0.9678	0.9729	(40)
HLP (average)												0.9654	(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		2.9303 (42)
Average daily hot water use (litres/day)		103.7941 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1735	110.0217	105.8699	101.7182	97.5664	93.4147	93.4147	97.5664	101.7182	105.8699	110.0217	114.1735	(44)
Energy conte	169.3160	148.0848	152.8103	133.2237	127.8313	110.3087	102.2172	117.2958	118.6966	138.3295	150.9975	163.9735	(45)
Energy content (annual)										Total = Sum(45)m =		1633.0847	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3974	22.2127	22.9215	19.9836	19.1747	16.5463	15.3326	17.5944	17.8045	20.7494	22.6496	24.5960	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)

Total heat required for water heating calculated for each month

	180.9899	158.6291	164.4842	144.5211	139.5053	121.6061	113.8912	128.9697	129.9940	150.0035	162.2949	175.6474	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-65.5243	-56.0992	-51.9336	-35.6708	-23.2718	-7.9422	-7.3596	-8.4453	-8.5462	-36.3033	-52.3134	-65.1458	eq.(G2)

Output from w/h

	115.4656	102.5299	112.5506	108.8503	116.2335	113.6639	106.5316	120.5244	121.4479	113.7001	109.9814	110.5017	(64)
								Total per year (kWh/year) = Sum(64)m =				1351.9809	(64)

Heat gains from water heating, kWh/month

	59.2160	51.8743	53.7279	47.1212	45.4224	39.5020	36.9057	41.9193	42.2910	48.9130	53.0310	57.4397	(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	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	(66)

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

	30.7432	27.3059	22.2066	16.8118	12.5670	10.6096	11.4641	14.9014	20.0007	25.3955	29.6403	31.5977	(67)

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

	317.8339	321.1320	312.8209	295.1274	272.7926	251.8010	237.7773	234.4792	242.7903	260.4838	282.8186	303.8102	(68)

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

	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	(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)

	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	(71)

Water heating gains (Table 5)

	79.5915	77.1938	72.2149	65.4461	61.0516	54.8639	49.6045	56.3432	58.7375	65.7433	73.6542	77.2039	(72)

Total internal gains

	498.1227	495.5859	477.1966	447.3395	416.3654	387.2286	368.8000	375.6780	391.4826	421.5768	456.0672	482.5659	(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	16.3000	10.6334	0.6300	0.7000	0.7700	52.9702	(74)
West	3.2300	19.6403	0.6300	0.7000	0.7700	19.9277	(80)

Solar gains	72.8979	140.2115	236.2114	369.9264	486.9436	515.9114	483.8321	391.1966	281.4807	166.7559	90.1930	60.5461	(83)
Total gains	571.0206	635.7974	713.4080	817.2660	903.3090	903.1400	852.6321	766.8746	672.9634	588.3327	546.2602	543.1120	(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	82.2358	82.4702	82.7013	83.8044	84.0140	85.0039	85.0039	85.1898	84.6199	84.0140	83.5910	83.1532	
alpha	6.4824	6.4980	6.5134	6.5870	6.6009	6.6669	6.6669	6.6793	6.6413	6.6009	6.5727	6.5435	
util living area	0.9999	0.9998	0.9994	0.9961	0.9728	0.8674	0.6992	0.7835	0.9717	0.9986	0.9998	1.0000	(86)
MIT	19.9279	20.0191	20.2009	20.4723	20.7430	20.9329	20.9874	20.9746	20.8144	20.4832	20.1654	19.9170	(87)
Th 2	20.0969	20.0992	20.1015	20.1123	20.1143	20.1237	20.1237	20.1255	20.1201	20.1143	20.1102	20.1060	(88)
util rest of house	0.9999	0.9998	0.9991	0.9940	0.9564	0.7950	0.5738	0.6631	0.9467	0.9977	0.9998	0.9999	(89)
MIT 2	18.6377	18.7730	19.0410	19.4454	19.8324	20.0746	20.1190	20.1140	19.9396	19.4640	18.9957	18.6286	(90)
Living area fraction									fLA = Living area / (4) =			0.1239	(91)
MIT	18.7975	18.9274	19.1847	19.5726	19.9452	20.1810	20.2266	20.2206	20.0479	19.5903	19.1407	18.7883	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6475	18.7774	19.0347	19.4226	19.7952	20.0310	20.0766	20.0706	19.8979	19.4403	18.9907	18.6383	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9996	0.9986	0.9915	0.9482	0.7858	0.5665	0.6546	0.9374	0.9964	0.9996	0.9999	(94)
Useful gains	570.9262	635.5508	712.3994	810.3522	856.4918	709.7291	483.0392	501.9835	630.8060	586.2314	546.0456	543.0493	(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	2082.4952	2008.5360	1809.1257	1498.7355	1150.1222	762.6169	488.1787	514.3055	817.8418	1255.9746	1697.9100	2072.5422	(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	1124.6073	922.6460	815.9643	495.6360	218.4610	0.0000	0.0000	0.0000	0.0000	498.2890	829.3424	1137.9426	(98)
Space heating												6042.8886	(98)
Space heating per m2											(98) / (4) =	40.9576	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6736.7766	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1124.6073	922.6460	815.9643	495.6360	218.4610	0.0000	0.0000	0.0000	0.0000	498.2890	829.3424	1137.9426	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1253.7428	1028.5909	909.6592	552.5485	243.5462	0.0000	0.0000	0.0000	0.0000	555.5061	924.5734	1268.6094	(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													
	115.4656	102.5299	112.5506	108.8503	116.2335	113.6639	106.5316	120.5244	121.4479	113.7001	109.9814	110.5017	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.4317	89.4119	89.3510	89.1826	88.7074	86.9000	86.9000	86.9000	86.9000	89.1662	89.3629	89.4449	(217)
Fuel for water heating, kWh/month													
	129.1104	114.6715	125.9645	122.0534	131.0302	130.7985	122.5910	138.6933	139.7559	127.5148	123.0728	123.5416	(219)
Water heating fuel used												1528.7979	(219)
Annual totals kWh/year													
Space heating fuel - main system												6736.7766	(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)												542.9349	(232)
Total delivered energy for all uses												8883.5094	(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	6736.7766	0.2160	1455.1437	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1528.7979	0.2160	330.2203	(264)
Space and water heating			1785.3641	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	542.9349	0.5190	281.7832	(268)
Total CO2, kg/year			2106.0723	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.2700	(273)

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

DER		14.2700	ZC1
Total Floor Area	TFA	147.5400	
Assumed number of occupants	N	2.9303	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.7655	ZC2
CO2 emissions from cooking, equation (L16)		1.2832	ZC3
Total CO2 emissions		28.3187	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		28.3187	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)	
Basement floor	147.5400 (1a)	x	2.5000 (2a)	=	368.8500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.8500	(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) =	0.1084	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3584	(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) =	0.3047	(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	0.3885	0.3808	0.3732	0.3351	0.3275	0.2894	0.2894	0.2818	0.3047	0.3275	0.3428	0.3580	(22b)
Effective ac	0.5755	0.5725	0.5697	0.5562	0.5536	0.5419	0.5419	0.5397	0.5464	0.5536	0.5587	0.5641	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			19.6200	1.3258	26.0114			(27)
GF			147.5400	0.1300	19.1802			(28a)
Main Type 3	95.9700	19.6200	76.3500	0.1800	13.7430			(29a)
Corridor	4.2300	1.9500	2.2800	0.1800	0.4104			(29a)
Total net area of external elements Aum(A, m2)			247.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2950			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.6036	(36)
Total fabric heat loss (33) + (36) =	74.8986	(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	70.0444	69.6877	69.3382	67.6963	67.3891	65.9590	65.9590	65.6942	66.5098	67.3891	68.0105	68.6602	(38)
Heat transfer coeff	144.9429	144.5863	144.2367	142.5948	142.2876	140.8576	140.8576	140.5927	141.4084	142.2876	142.9091	143.5588	(39)
Average = Sum(39)m / 12 =												142.5933	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9824	0.9800	0.9776	0.9665	0.9644	0.9547	0.9547	0.9529	0.9584	0.9644	0.9686	0.9730	(40)
HLP (average)												0.9665	(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	2.9303	(42)
Average daily hot water use (litres/day)	103.7941	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1735	110.0217	105.8699	101.7182	97.5664	93.4147	93.4147	97.5664	101.7182	105.8699	110.0217	114.1735	(44)
Energy conte	169.3160	148.0848	152.8103	133.2237	127.8313	110.3087	102.2172	117.2958	118.6966	138.3295	150.9975	163.9735	(45)
Energy content (annual)										Total = Sum(45)m =		1633.0847	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3974	22.2127	22.9215	19.9836	19.1747	16.5463	15.3326	17.5944	17.8045	20.7494	22.6496	24.5960	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	49.7188	46.0675	47.6031	49.7188	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	220.2749	194.1122	203.7692	182.5388	177.5501	156.3762	149.8203	167.0145	168.0117	189.2884	200.3125	214.9324	(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													
	220.2749	194.1122	203.7692	182.5388	177.5501	156.3762	149.8203	167.0145	168.0117	189.2884	200.3125	214.9324	(64)
									Total per year (kWh/year) = Sum(64)m =			2224.0011	(64)
Heat gains from water heating, kWh/month													
	69.0373	60.7450	63.5491	56.6256	54.9336	48.1945	45.8880	51.4305	51.7954	58.7343	62.5354	67.2609	(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	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7432	27.3059	22.2066	16.8118	12.5670	10.6096	11.4641	14.9014	20.0007	25.3955	29.6403	31.5977	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	317.8339	321.1320	312.8209	295.1274	272.7926	251.8010	237.7773	234.4792	242.7903	260.4838	282.8186	303.8102	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	(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)													
	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	(71)
Water heating gains (Table 5)													
	92.7920	90.3944	85.4155	78.6467	73.8355	66.9368	61.6774	69.1271	71.9381	78.9439	86.8548	90.4044	(72)
Total internal gains													
	511.3233	508.7865	490.3971	460.5401	429.1492	399.3016	380.8729	388.4618	404.6832	434.7773	469.2678	495.7665	(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	16.3000	10.6334	0.6300	0.7000	0.7700	52.9702	(74)
West	3.2000	19.6403	0.6300	0.7000	0.7700	19.9277	(80)

Solar gains	72.8979	140.2115	236.2114	369.9264	486.9436	515.9114	483.8321	391.1966	281.4807	166.7559	90.1930	60.5461	(83)
Total gains	584.2212	648.9980	726.6085	830.4665	916.0928	915.2130	864.7050	779.6584	686.1640	601.5333	559.4608	556.3126	(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	70.6887	70.8631	71.0348	71.8528	72.0079	72.7390	72.7390	72.8760	72.4556	72.0079	71.6948	71.3703	
alpha	5.7126	5.7242	5.7357	5.7902	5.8005	5.8493	5.8493	5.8584	5.8304	5.8005	5.7797	5.7580	
util living area													
	0.9998	0.9995	0.9985	0.9924	0.9603	0.8475	0.6845	0.7640	0.9581	0.9968	0.9995	0.9998	(86)
MIT	19.7942	19.8970	20.1023	20.4065	20.7078	20.9169	20.9816	20.9663	20.7901	20.4201	20.0605	19.7795	(87)
Th 2	20.0980	20.1000	20.1020	20.1114	20.1131	20.1212	20.1212	20.1228	20.1181	20.1131	20.1096	20.1059	(88)
util rest of house													
	0.9997	0.9993	0.9979	0.9890	0.9406	0.7765	0.5639	0.6485	0.9283	0.9949	0.9993	0.9998	(89)
MIT 2	18.4576	18.6096	18.9115	19.3616	19.7895	20.0564	20.1131	20.1055	19.9114	19.3845	18.8561	18.4419	(90)
Living area fraction									fLA = Living area / (4) =			0.1239	(91)
MIT	18.6232	18.7691	19.0591	19.4911	19.9033	20.1630	20.2207	20.2122	20.0202	19.5128	19.0053	18.6076	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6232	18.7691	19.0591	19.4911	19.9033	20.1630	20.2207	20.2122	20.0202	19.5128	19.0053	18.6076	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9989	0.9968	0.9856	0.9346	0.7804	0.5785	0.6615	0.9239	0.9930	0.9989	0.9996	(94)
Useful gains	583.9210	648.3090	724.2962	818.5443	856.2166	714.1876	500.2100	515.7769	633.9285	597.3280	558.8539	556.1010	(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													
	2076.0518	2005.2829	1811.4787	1510.2293	1167.2244	783.5932	510.0100	535.9642	837.1699	1268.1803	1701.3720	2068.3425	(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													
	1110.1453	911.8865	808.8637	498.0132	231.3898	0.0000	0.0000	0.0000	0.0000	499.1141	822.6130	1125.1077	(98)
Space heating												6007.1333	(98)
Space heating per m2											(98) / (4) =	40.7153	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	6431.6202 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1110.1453	911.8865	808.8637	498.0132	231.3898	0.0000	0.0000	0.0000	0.0000	499.1141	822.6130	1125.1077	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1188.5924	976.3238	866.0211	533.2047	247.7407	0.0000	0.0000	0.0000	0.0000	534.3834	880.7420	1204.6121	(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													
	220.2749	194.1122	203.7692	182.5388	177.5501	156.3762	149.8203	167.0145	168.0117	189.2884	200.3125	214.9324	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.5558	88.4475	88.1685	87.4498	85.7189	80.3000	80.3000	80.3000	80.3000	87.3780	88.2269	88.6123	(217)
Fuel for water heating, kWh/month													
	248.7412	219.4660	231.1135	208.7356	207.1305	194.7400	186.5757	207.9882	209.2300	216.6316	227.0423	242.5535	(219)
Water heating fuel used												2599.9481	(219)
Annual totals kWh/year													
Space heating fuel - main system												6431.6202	(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)	542.9349 (232)
Total delivered energy for all uses	9649.5033 (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	6431.6202	0.2160	1389.2300	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2599.9481	0.2160	561.5888	(264)
Space and water heating			1950.8188	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	542.9349	0.5190	281.7832	(268)
Total CO2, kg/m2/year			2271.5270	(272)
Emissions per m2 for space and water heating			13.2223	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9099	(272b)
Emissions per m2 for pumps and fans			0.2638	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.2223 * 1.00) + 1.9099 + 0.2638, rounded to 2 d.p.			15.4000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-02	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT LGF
Property	Plot 2, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.60	**TER**	15.83
Environmental	87 B	**% DER<TER**	7.76		
CO_2 Emissions (t/year)	1.73	**DFEE**	45.30	**TFEE**	52.81
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.22		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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)	
Basement floor	146.1800 (1a)	x	2.5000 (2a)	=	365.4500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4500	(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) =	0.1368	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3868	(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) =	0.3288	(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	0.4192	0.4110	0.4028	0.3617	0.3535	0.3124	0.3124	0.3041	0.3288	0.3535	0.3699	0.3863	(22b)
Effective ac	0.5879	0.5845	0.5811	0.5654	0.5625	0.5488	0.5488	0.5462	0.5541	0.5625	0.5684	0.5746	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			20.0300	1.3258	26.5549			(27)
GF			146.1800	0.1200	17.5416	75.0000	10963.5000	(28a)
Main Type 3	92.4900	20.0300	72.4600	0.1700	12.3182	110.0000	7970.6000	(29a)
Corridor	9.0600	1.9500	7.1100	0.2257	1.6050	110.0000	782.1000	(29a)
Total net area of external elements Aum(A, m2)			247.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.3597			(33)
Party Wall 1			21.9000	0.0000	0.0000	20.0000	438.0000	(32)
Party Ceilings 1			146.1800			30.0000	4385.4000	(32b)
Internal Wall 1			246.9000			75.0000	18517.5000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		43057.1000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							294.5485	(35)
Thermal bridges (User defined value 0.049 * total exposed area)							12.1388	(36)
Total fabric heat loss					(33) + (36) =		72.4985	(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	70.8962	70.4847	70.0814	68.1869	67.8324	66.1824	66.1824	65.8768	66.8180	67.8324	68.5495	69.2992	(38)
Heat transfer coeff	143.3947	142.9832	142.5799	140.6854	140.3309	138.6809	138.6809	138.3753	139.3164	140.3309	141.0480	141.7976	(39)
Average = Sum(39)m / 12 =												140.6837	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9809	0.9781	0.9754	0.9624	0.9600	0.9487	0.9487	0.9466	0.9530	0.9600	0.9649	0.9700	(40)
HLP (average)												0.9624	(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		2.9280 (42)
Average daily hot water use (litres/day)		103.7410 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1151	109.9655	105.8158	101.6662	97.5166	93.3669	93.3669	97.5166	101.6662	105.8158	109.9655	114.1151	(44)
Energy conte	169.2294	148.0092	152.7322	133.1556	127.7660	110.2523	102.1650	117.2358	118.6360	138.2588	150.9203	163.8897	(45)
Energy content (annual)										Total = Sum(45)m =		1632.2503	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3844	22.2014	22.9098	19.9733	19.1649	16.5379	15.3247	17.5854	17.7954	20.7388	22.6380	24.5835	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)

Total heat required for water heating calculated for each month

	180.9034	158.5534	164.4062	144.4530	139.4400	121.5497	113.8390	128.9098	129.9334	149.9328	162.2177	175.5637	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-65.8330	-56.7803	-52.9520	-36.7202	-24.1137	-7.9382	-7.3559	-8.4410	-8.5418	-37.1756	-52.9065	-65.4134	eq.(G2)
Output from w/h													
	115.0704	101.7731	111.4541	107.7328	115.3263	113.6116	106.4831	120.4688	121.3916	112.7572	109.3113	110.1502	(64)
									Total per year (kWh/year) = Sum(64)m =			1345.5305	(64)

Heat gains from water heating, kWh/month

	59.1873	51.8491	53.7019	47.0986	45.4007	39.4833	36.8884	41.8994	42.2708	48.8896	53.0054	57.4118	(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	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	(66)

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

	30.3974	26.9987	21.9568	16.6227	12.4257	10.4903	11.3351	14.7338	19.7757	25.1098	29.3069	31.2423	(67)

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

	316.3358	319.6183	311.3463	293.7363	271.5067	250.6141	236.6565	233.3739	241.6459	259.2560	281.4855	302.3782	(68)

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

	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	(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)

	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	(71)

Water heating gains (Table 5)

	79.5528	77.1564	72.1800	65.4147	61.0224	54.8378	49.5811	56.3164	58.7095	65.7118	73.6185	77.1664	(72)

Total internal gains

	496.2066	493.6941	475.4039	445.6944	414.8755	385.8629	367.4934	374.3448	390.0518	419.9982	454.3316	480.7075	(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	20.0300	10.6334	0.6300	0.7000	0.7700	65.0915	(74)

Solar gains	65.0915	124.3933	211.3746	339.5218	457.3669	489.6249	457.1274	362.6723	254.1407	148.0740	80.2988	54.2635	(83)
Total gains	561.2982	618.0874	686.7785	785.2162	872.2424	875.4877	824.6208	737.0171	644.1925	568.0722	534.6304	534.9711	(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	83.4083	83.6483	83.8850	85.0146	85.2293	86.2434	86.2434	86.4338	85.8499	85.2293	84.7960	84.3477	
alpha	6.5606	6.5766	6.5923	6.6676	6.6820	6.7496	6.7496	6.7623	6.7233	6.6820	6.6531	6.6232	
util living area													
	0.9999	0.9999	0.9995	0.9969	0.9765	0.8768	0.7121	0.7993	0.9766	0.9989	0.9999	1.0000	(86)
MIT	19.9389	20.0249	20.2000	20.4662	20.7367	20.9302	20.9866	20.9724	20.8069	20.4820	20.1725	19.9290	(87)
Th 2	20.0992	20.1016	20.1039	20.1148	20.1168	20.1263	20.1263	20.1281	20.1226	20.1168	20.1127	20.1084	(88)
util rest of house													
	0.9999	0.9998	0.9993	0.9952	0.9618	0.8063	0.5858	0.6799	0.9548	0.9981	0.9998	0.9999	(89)
MIT 2	18.6546	18.7823	19.0405	19.4377	19.8257	20.0748	20.1212	20.1154	19.9319	19.4631	19.0070	18.6471	(90)
Living area fraction									fLA = Living area / (4) =			0.2846	(91)
MIT	19.0201	19.1360	19.3706	19.7305	20.0850	20.3183	20.3676	20.3594	20.1810	19.7531	19.3388	19.0120	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8701	18.9860	19.2206	19.5805	19.9350	20.1683	20.2176	20.2094	20.0310	19.6031	19.1888	18.8620	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9997	0.9990	0.9937	0.9577	0.8103	0.5999	0.6924	0.9516	0.9974	0.9997	0.9999	(94)
Useful gains	561.2243	617.9063	686.0703	780.2316	835.3499	709.4398	494.6728	510.3153	613.0074	566.5711	534.4669	534.9216	(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													
	2089.2819	2014.0665	1813.6963	1502.5840	1155.6286	772.2161	501.6860	527.1245	826.2832	1263.4170	1705.0997	2079.0301	(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													
	1136.8748	938.2197	838.9538	520.0937	238.2874	0.0000	0.0000	0.0000	0.0000	518.4533	842.8556	1148.8168	(98)
Space heating												6182.5551	(98)
Space heating per m2											(98) / (4) =	42.2941	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6892.4806	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1136.8748	938.2197	838.9538	520.0937	238.2874	0.0000	0.0000	0.0000	0.0000	518.4533	842.8556	1148.8168	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1267.4190	1045.9528	935.2885	579.8146	265.6492	0.0000	0.0000	0.0000	0.0000	577.9859	939.6384	1280.7322	(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													
	115.0704	101.7731	111.4541	107.7328	115.3263	113.6116	106.4831	120.4688	121.3916	112.7572	109.3113	110.1502	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.4351	89.4181	89.3623	89.2068	88.7672	86.9000	86.9000	86.9000	86.9000	89.1867	89.3694	89.4478	(217)
Fuel for water heating, kWh/month													
	128.6636	113.8172	124.7216	120.7675	129.9199	130.7383	122.5352	138.6293	139.6911	126.4283	122.3139	123.1446	(219)
Water heating fuel used												1521.3706	(219)
Annual totals kWh/year													
Space heating fuel - main system												6892.4806	(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)												536.8282	(232)
Total delivered energy for all uses												9025.6794	(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	6892.4806	0.2160	1488.7758	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1521.3706	0.2160	328.6160	(264)
Space and water heating			1817.3918	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	536.8282	0.5190	278.6138	(268)
Total CO2, kg/year			2134.9307	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.6000	(273)

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

DER		14.6000	ZC1
Total Floor Area	TFA	146.1800	
Assumed number of occupants	N	2.9280	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.8235	ZC2
CO2 emissions from cooking, equation (L16)		1.2948	ZC3
Total CO2 emissions		28.7183	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		28.7183	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)	
Basement floor	146.1800 (1a)	x	2.5000 (2a)	=	365.4500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4500	(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) =	0.1095	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3595	(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) =	0.3055	(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	0.3896	0.3819	0.3743	0.3361	0.3285	0.2903	0.2903	0.2826	0.3055	0.3285	0.3437	0.3590	(22b)
Effective ac	0.5759	0.5729	0.5700	0.5565	0.5539	0.5421	0.5421	0.5399	0.5467	0.5539	0.5591	0.5644	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			20.0300	1.3258	26.5549			(27)
GF			146.1800	0.1300	19.0034			(28a)
Main Type 3	92.4900	20.0300	72.4600	0.1800	13.0428			(29a)
Corridor	9.0600	1.9500	7.1100	0.1800	1.2798			(29a)
Total net area of external elements Aum(A, m2)			247.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.8309			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.0259	(36)
Total fabric heat loss (33) + (36) =	74.8568	(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	69.4500	69.0947	68.7464	67.1104	66.8043	65.3795	65.3795	65.1156	65.9283	66.8043	67.4235	68.0709	(38)
Heat transfer coeff	144.3068	143.9515	143.6032	141.9672	141.6612	140.2363	140.2363	139.9724	140.7851	141.6612	142.2804	142.9277	(39)
Average = Sum(39)m / 12 =												141.9658	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9872	0.9848	0.9824	0.9712	0.9691	0.9593	0.9593	0.9575	0.9631	0.9691	0.9733	0.9778	(40)
HLP (average)												0.9712	(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	2.9280 (42)
Average daily hot water use (litres/day)	103.7410 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1151	109.9655	105.8158	101.6662	97.5166	93.3669	93.3669	97.5166	101.6662	105.8158	109.9655	114.1151	(44)
Energy conte	169.2294	148.0092	152.7322	133.1556	127.7660	110.2523	102.1650	117.2358	118.6360	138.2588	150.9203	163.8897	(45)
Energy content (annual)										Total = Sum(45)m =		1632.2503	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3844	22.2014	22.9098	19.9733	19.1649	16.5379	15.3247	17.5854	17.7954	20.7388	22.6380	24.5835	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	49.6934	46.0440	47.5788	49.6934	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	220.1883	194.0365	203.6911	182.4707	177.4594	156.2963	149.7438	166.9292	167.9511	189.2177	200.2354	214.8486	(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													
	220.1883	194.0365	203.6911	182.4707	177.4594	156.2963	149.7438	166.9292	167.9511	189.2177	200.2354	214.8486	(64)
									Total per year (kWh/year) = Sum(64)m =			2223.0680	(64)
Heat gains from water heating, kWh/month													
	69.0085	60.7199	63.5232	56.6030	54.9055	48.1699	45.8646	51.4043	51.7752	58.7108	62.5098	67.2330	(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	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.3974	26.9987	21.9568	16.6227	12.4257	10.4903	11.3351	14.7338	19.7757	25.1098	29.3069	31.2423	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	316.3358	319.6183	311.3463	293.7363	271.5067	250.6141	236.6565	233.3739	241.6459	259.2560	281.4855	302.3782	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	(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)													
	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	(71)
Water heating gains (Table 5)													
	92.7534	90.3570	85.3806	78.6153	73.7978	66.9026	61.6459	69.0917	71.9100	78.9123	86.8191	90.3670	(72)
Total internal gains													
	509.4072	506.8947	488.6045	458.8950	427.6508	397.9276	379.5582	387.1202	403.2523	433.1988	467.5322	493.9081	(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	20.0300	10.6334	0.6300	0.7000	0.7700	65.0915	(74)

Solar gains	65.0915	124.3933	211.3746	339.5218	457.3669	489.6249	457.1274	362.6723	254.1407	148.0740	80.2988	54.2635	(83)
Total gains	574.4988	631.2880	699.9790	798.4168	885.0178	887.5525	836.6856	749.7924	657.3931	581.2728	547.8310	548.1716	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.3459	70.5195	70.6905	71.5051	71.6596	72.3877	72.3877	72.5242	72.1055	71.6596	71.3478	71.0246	
alpha	5.6897	5.7013	5.7127	5.7670	5.7773	5.8258	5.8258	5.8349	5.8070	5.7773	5.7565	5.7350	
util living area													
	0.9998	0.9996	0.9987	0.9935	0.9647	0.8582	0.6999	0.7816	0.9640	0.9972	0.9996	0.9998	(86)
MIT	19.7847	19.8828	20.0834	20.3860	20.6919	20.9096	20.9791	20.9615	20.7754	20.4063	20.0506	19.7709	(87)
Th 2	20.0940	20.0961	20.0980	20.1074	20.1092	20.1174	20.1174	20.1189	20.1142	20.1092	20.1056	20.1019	(88)
util rest of house													
	0.9997	0.9994	0.9982	0.9906	0.9467	0.7891	0.5781	0.6667	0.9374	0.9956	0.9994	0.9998	(89)
MIT 2	18.4407	18.5859	18.8809	19.3291	19.7653	20.0459	20.1080	20.0988	19.8897	19.3615	18.8388	18.4264	(90)
Living area fraction										fLA = Living area / (4) =		0.2846	(91)
MIT	18.8233	18.9550	19.2232	19.6299	20.0291	20.2917	20.3560	20.3443	20.1418	19.6589	19.1837	18.8091	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8233	18.9550	19.2232	19.6299	20.0291	20.2917	20.3560	20.3443	20.1418	19.6589	19.1837	18.8091	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9991	0.9974	0.9884	0.9447	0.8046	0.6131	0.6992	0.9385	0.9943	0.9991	0.9997	(94)
Useful gains	574.2344	630.7202	698.1775	789.1428	836.0482	714.1548	512.9731	524.2574	616.9478	577.9816	547.3146	547.9830	(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													
	2095.8107	2023.2439	1827.0854	1523.2998	1179.9043	798.1859	526.7230	552.0982	850.5957	1283.2937	1719.2788	2088.0413	(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													
	1132.0528	935.7759	839.9075	528.5930	255.8289	0.0000	0.0000	0.0000	0.0000	524.7522	843.8142	1145.8034	(98)
Space heating												6206.5281	(98)
Space heating per m2											(98) / (4) =	42.4581	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6645.1050	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1132.0528	935.7759	839.9075	528.5930	255.8289	0.0000	0.0000	0.0000	0.0000	524.7522	843.8142	1145.8034	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1212.0480	1001.9014	899.2586	565.9454	273.9068	0.0000	0.0000	0.0000	0.0000	561.8332	903.4414	1226.7703	(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													
	220.1883	194.0365	203.6911	182.4707	177.4594	156.2963	149.7438	166.9292	167.9511	189.2177	200.2354	214.8486	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.5857	88.4885	88.2339	87.5734	85.9713	80.3000	80.3000	80.3000	80.3000	87.4838	88.2707	88.6396	(217)
Fuel for water heating, kWh/month													
	248.5597	219.2788	230.8536	208.3631	206.4171	194.6405	186.4804	207.8819	209.1545	216.2888	226.8425	242.3845	(219)
Water heating fuel used												2597.1454	(219)
Annual totals kWh/year													
Space heating fuel - main system												6645.1050	(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)												536.8282	(232)
Total delivered energy for all uses												9854.0786	(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	6645.1050	0.2160	1435.3427	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.1454	0.2160	560.9834	(264)
Space and water heating			1996.3261	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	536.8282	0.5190	278.6138	(268)
Total CO2, kg/m2/year			2313.8649	(272)
Emissions per m2 for space and water heating			13.6566	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9060	(272b)
Emissions per m2 for pumps and fans			0.2663	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.6566 * 1.00) + 1.9060 + 0.2663, rounded to 2 d.p.			15.8300	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-03	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT GF
Property	Plot 3, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.26	**TER**	15.78
Environmental	87 B	**% DER<TER**	9.65		
CO_2 Emissions (t/year)	1.57	**DFEE**	44.12	**TFEE**	51.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.99		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	135.3300 (1b)	x	2.6600 (2b)	=	359.9778	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	135.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	359.9778	(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) =	0.1111	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3611	(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) =	0.3070	(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	0.3914	0.3837	0.3760	0.3376	0.3300	0.2916	0.2916	0.2839	0.3070	0.3300	0.3453	0.3607	(22b)
Effective ac	0.5766	0.5736	0.5707	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
GF			135.3300	0.1200	16.2396	75.0000	10149.7500	(28a)
Main Type 3	107.1700	21.0000	86.1700	0.1700	14.6489	110.0000	9478.7000	(29a)
Corridor	3.3500	1.9500	1.4000	0.2257	0.3160	110.0000	154.0000	(29a)
Total net area of external elements Aum(A, m2)			245.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.3854			(33)
Party Wall 1			33.5800	0.0000	0.0000	20.0000	671.6000	(32)
Party Ceilings 1			135.3300			30.0000	4059.9000	(32b)
Internal Wall 1			228.2800			75.0000	17121.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	41634.9500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		307.6550 (35)
Thermal bridges (User defined value 0.060 * total exposed area)		14.7510 (36)
Total fabric heat loss	(33) + (36) =	76.1364 (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	68.4937	68.1404	67.7942	66.1678	65.8635	64.4469	64.4469	64.1846	64.9926	65.8635	66.4791	67.1226	(38)
Heat transfer coeff	144.6301	144.2769	143.9306	142.3042	141.9999	140.5834	140.5834	140.3210	141.1290	141.9999	142.6155	143.2591	(39)
Average = Sum(39)m / 12 =												142.3028	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0687	1.0661	1.0636	1.0515	1.0493	1.0388	1.0388	1.0369	1.0429	1.0493	1.0538	1.0586	(40)
HLP (average)												1.0515	(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	2.9076 (42)
Average daily hot water use (litres/day)	103.2558 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.5814	109.4511	105.3209	101.1907	97.0604	92.9302	92.9302	97.0604	101.1907	105.3209	109.4511	113.5814	(44)
Energy conte	168.4379	147.3168	152.0178	132.5328	127.1684	109.7366	101.6871	116.6875	118.0811	137.6121	150.2144	163.1231	(45)
Energy content (annual)										Total = Sum(45)m =		1624.6156	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2657	22.0975	22.8027	19.8799	19.0753	16.4605	15.2531	17.5031	17.7122	20.6418	22.5322	24.4685	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss

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

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss 11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)

Total heat required for water heating calculated for each month

180.1119	157.8611	163.6918	143.8302	138.8424	121.0340	113.3611	128.3614	129.3785	149.2861	161.5118	174.7971	(62)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =											0.0000	(63)
FGHRS -64.1544	-52.3209	-46.1418	-30.0404	-17.8208	-7.9010	-7.3215	-8.4015	-8.5018	-31.9713	-49.6976	-64.0698	eq.(G2)
Output from w/h												
115.9575	105.5401	117.5500	113.7898	121.0215	113.1330	106.0396	119.9599	120.8766	117.3148	111.8142	110.7273	(64)
Total per year (kWh/year) = Sum(64)m =											1373.7244	(64)

Heat gains from water heating, kWh/month

58.9241	51.6189	53.4644	46.8915	45.2020	39.3118	36.7295	41.7171	42.0863	48.6745	52.7706	57.1569	(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	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	(66)

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

28.4524	25.2712	20.5519	15.5591	11.6306	9.8191	10.6098	13.7911	18.5103	23.5031	27.4316	29.2432	(67)

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

304.0365	307.1915	299.2411	282.3157	260.9504	240.8701	227.4552	224.3003	232.2506	249.1760	270.5413	290.6216	(68)

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

37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	(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)

-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	(71)

Water heating gains (Table 5)

79.1990	76.8139	71.8608	65.1271	60.7553	54.5997	49.3676	56.0713	58.4532	65.4227	73.2925	76.8238	(72)

Total internal gains

481.3021	478.8906	461.2679	432.6161	402.9506	374.9030	357.0468	363.7768	378.8283	407.7161	440.8796	466.3028	(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	8.8400	19.6403	0.6300	0.7000	0.7700	53.0605	(76)
South	4.4200	46.7521	0.6300	0.7000	0.7700	63.1531	(78)
West	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(80)

Solar gains 162.6716	298.1078	452.3586	616.4947	728.2169	735.9455	704.3864	621.4210	510.5095	342.5607	198.9458	136.4093	(83)
Total gains 643.9737	776.9984	913.6265	1049.1108	1131.1674	1110.8486	1061.4331	985.1979	889.3379	750.2768	639.8254	602.7120	(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	79.9644	80.1602	80.3530	81.2714	81.4456	82.2662	82.2662	82.4200	81.9482	81.4456	81.0940	80.7297	
alpha	6.3310	6.3440	6.3569	6.4181	6.4297	6.4844	6.4844	6.4947	6.4632	6.4297	6.4063	6.3820	
util living area													
	0.9998	0.9994	0.9970	0.9833	0.9224	0.7605	0.5753	0.6400	0.9019	0.9936	0.9995	0.9999	(86)
MIT	19.9470	20.0805	20.3004	20.5886	20.8348	20.9672	20.9953	20.9911	20.8975	20.5640	20.1999	19.9259	(87)
Th 2	20.0265	20.0286	20.0307	20.0406	20.0425	20.0511	20.0511	20.0527	20.0478	20.0425	20.0387	20.0348	(88)
util rest of house													
	0.9998	0.9991	0.9957	0.9749	0.8845	0.6693	0.4555	0.5166	0.8397	0.9893	0.9993	0.9998	(89)
MIT 2	18.6068	18.8037	19.1265	19.5495	19.8817	20.0312	20.0497	20.0496	19.9668	19.5198	18.9864	18.5822	(90)
Living area fraction									fLA = Living area / (4) =			0.2226	(91)
MIT	18.9051	19.0878	19.3877	19.7808	20.0938	20.2395	20.2601	20.2591	20.1740	19.7522	19.2565	18.8813	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7551	18.9378	19.2377	19.6308	19.9438	20.0895	20.1101	20.1091	20.0240	19.6022	19.1065	18.7313	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9986	0.9940	0.9700	0.8798	0.6733	0.4632	0.5243	0.8378	0.9863	0.9989	0.9997	(94)
Useful gains	643.7159	775.8993	908.1188	1017.6563	995.1695	747.9724	491.6199	516.5461	745.0943	740.0040	639.0937	602.5549	(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													
	2090.6387	2025.3366	1833.3496	1527.0378	1170.6238	771.7300	493.4655	520.4714	836.0442	1278.3087	1712.3132	2081.7365	(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													
	1076.5106	839.6219	688.3717	366.7547	130.5380	0.0000	0.0000	0.0000	0.0000	400.4987	772.7180	1100.5111	(98)
Space heating												5375.5247	(98)
Space heating per m2											(98) / (4) =	39.7216	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5992.7812	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1076.5106	839.6219	688.3717	366.7547	130.5380	0.0000	0.0000	0.0000	0.0000	400.4987	772.7180	1100.5111	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1200.1233	936.0333	767.4155	408.8681	145.5273	0.0000	0.0000	0.0000	0.0000	446.4869	861.4471	1226.8797	(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													
	115.9575	105.5401	117.5500	113.7898	121.0215	113.1330	106.0396	119.9599	120.8766	117.3148	111.8142	110.7273	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.4198	89.3784	89.2804	89.0208	88.3308	86.9000	86.9000	86.9000	86.9000	89.0499	89.3361	89.4366	(217)
Fuel for water heating, kWh/month													
	129.6776	118.0824	131.6638	127.8238	137.0095	130.1876	122.0249	138.0437	139.0986	131.7404	125.1613	123.8054	(219)
Water heating fuel used												1554.3188	(219)
Annual totals kWh/year													
Space heating fuel - main system												5992.7812	(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)												502.4781	(232)
Total delivered energy for all uses												8124.5780	(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	5992.7812	0.2160	1294.4407	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1554.3188	0.2160	335.7329	(264)
Space and water heating			1630.1736	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	502.4781	0.5190	260.7861	(268)
Total CO2, kg/year			1929.8847	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.2600	(273)

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

DER		14.2600	ZC1
Total Floor Area	TFA	135.3300	
Assumed number of occupants	N	2.9076	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.3131	ZC2
CO2 emissions from cooking, equation (L16)		1.3950	ZC3
Total CO2 emissions		28.9680	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		28.9680	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	135.3300 (1b)	x	2.6600 (2b)	=	359.9778	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	135.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	359.9778	(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) =	0.1111	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3611	(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) =	0.3070	(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	0.3914	0.3837	0.3760	0.3376	0.3300	0.2916	0.2916	0.2839	0.3070	0.3300	0.3453	0.3607	(22b)
Effective ac	0.5766	0.5736	0.5707	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
GF			135.3300	0.1300	17.5929			(28a)
Main Type 3	107.1700	21.0000	86.1700	0.1800	15.5106			(29a)
Corridor	3.3500	1.9500	1.4000	0.1800	0.2520			(29a)
Total net area of external elements Aum(A, m2)			245.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.1464			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.1299	(36)
Total fabric heat loss (33) + (36) =	79.2763	(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	68.4937	68.1404	67.7942	66.1678	65.8635	64.4469	64.4469	64.1846	64.9926	65.8635	66.4791	67.1226	(38)
Heat transfer coeff	147.7700	147.4168	147.0705	145.4441	145.1398	143.7232	143.7232	143.4609	144.2689	145.1398	145.7554	146.3989	(39)
Average = Sum(39)m / 12 =												145.4426	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0919	1.0893	1.0868	1.0747	1.0725	1.0620	1.0620	1.0601	1.0661	1.0725	1.0770	1.0818	(40)
HLP (average)												1.0747	(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	2.9076 (42)
Average daily hot water use (litres/day)	103.2558 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.5814	109.4511	105.3209	101.1907	97.0604	92.9302	92.9302	97.0604	101.1907	105.3209	109.4511	113.5814	(44)
Energy conte	168.4379	147.3168	152.0178	132.5328	127.1684	109.7366	101.6871	116.6875	118.0811	137.6121	150.2144	163.1231	(45)
Energy content (annual)										Total = Sum(45)m =		1624.6156	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2657	22.0975	22.8027	19.8799	19.0753	16.4605	15.2531	17.5031	17.7122	20.6418	22.5322	24.4685	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	49.4609	45.8286	47.3562	49.4609	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	219.3968	193.3442	202.9767	181.8479	176.6293	155.5652	149.0433	166.1484	167.3961	188.5710	199.5295	214.0820	(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													
	219.3968	193.3442	202.9767	181.8479	176.6293	155.5652	149.0433	166.1484	167.3961	188.5710	199.5295	214.0820	(64)
									Total per year (kWh/year) = Sum(64)m =			2214.5305	(64)
Heat gains from water heating, kWh/month													
	68.7453	60.4897	63.2856	56.3959	54.6487	47.9446	45.6500	51.1638	51.5907	58.4958	62.2750	66.9782	(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	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.4524	25.2712	20.5519	15.5591	11.6306	9.8191	10.6098	13.7911	18.5103	23.5031	27.4316	29.2432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.0365	307.1915	299.2411	282.3157	260.9504	240.8701	227.4552	224.3003	232.2506	249.1760	270.5413	290.6216	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	(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)													
	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	(71)
Water heating gains (Table 5)													
	92.3996	90.0144	85.0613	78.3277	73.4526	66.5897	61.3576	68.7686	71.6538	78.6233	86.4931	90.0244	(72)
Total internal gains													
	494.5027	492.0912	474.4685	445.8166	415.6478	386.8930	369.0368	376.4741	392.0289	420.9166	454.0802	479.5034	(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	8.8400	19.6403	0.6300	0.7000	0.7700	53.0605	(76)
South	4.2400	46.7521	0.6300	0.7000	0.7700	63.1531	(78)
West	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(80)

Solar gains	162.6716	298.1078	452.3586	616.4947	728.2169	735.9455	704.3864	621.4210	510.5095	342.5607	198.9458	136.4093	(83)
Total gains	657.1743	790.1990	926.8271	1062.3114	1143.8647	1122.8386	1073.4231	997.8951	902.5385	763.4773	653.0260	615.9126	(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	63.5983	63.7507	63.9008	64.6153	64.7508	65.3890	65.3890	65.5085	65.1417	64.7508	64.4773	64.1939	
alpha	5.2399	5.2500	5.2601	5.3077	5.3167	5.3593	5.3593	5.3672	5.3428	5.3167	5.2985	5.2796	
util living area													
	0.9993	0.9979	0.9929	0.9716	0.9024	0.7484	0.5744	0.6351	0.8805	0.9866	0.9983	0.9995	(86)
MIT	19.7297	19.8879	20.1489	20.4880	20.7765	20.9440	20.9889	20.9815	20.8585	20.4677	20.0336	19.7043	(87)
Th 2	20.0074	20.0096	20.0117	20.0215	20.0234	20.0320	20.0320	20.0336	20.0287	20.0234	20.0196	20.0157	(88)
util rest of house													
	0.9990	0.9972	0.9903	0.9604	0.8637	0.6618	0.4556	0.5146	0.8189	0.9796	0.9976	0.9993	(89)
MIT 2	18.2974	18.5301	18.9121	19.4059	19.7965	19.9931	20.0277	20.0256	19.9086	19.3843	18.7509	18.2662	(90)
Living area fraction									fLA = Living area / (4) =			0.2226	(91)
MIT	18.6162	18.8323	19.1873	19.6467	20.0146	20.2047	20.2416	20.2383	20.1201	19.6255	19.0364	18.5862	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6162	18.8323	19.1873	19.6467	20.0146	20.2047	20.2416	20.2383	20.1201	19.6255	19.0364	18.5862	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9985	0.9959	0.9872	0.9548	0.8633	0.6785	0.4822	0.5414	0.8257	0.9755	0.9965	0.9989	(94)
Useful gains	656.1836	786.9630	914.9209	1014.2880	987.5317	761.8498	517.6132	540.2639	745.2378	744.8073	650.7529	615.2514	(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													
	2115.5090	2053.8585	1865.9333	1563.0494	1206.7802	805.5264	523.3828	550.6495	868.5064	1309.9537	1739.7908	2106.1291	(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													
	1085.7381	851.3538	707.5532	395.1082	163.1209	0.0000	0.0000	0.0000	0.0000	420.4689	784.1073	1109.2130	(98)
Space heating												5516.6634	(98)
Space heating per m2											(98) / (4) =	40.7645	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5906.4918	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1085.7381	851.3538	707.5532	395.1082	163.1209	0.0000	0.0000	0.0000	0.0000	420.4689	784.1073	1109.2130	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1162.4605	911.5137	757.5516	423.0280	174.6476	0.0000	0.0000	0.0000	0.0000	450.1808	839.5153	1187.5943	(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													
	219.3968	193.3442	202.9767	181.8479	176.6293	155.5652	149.0433	166.1484	167.3961	188.5710	199.5295	214.0820	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.5282	88.3435	87.9344	86.9529	84.8516	80.3000	80.3000	80.3000	80.3000	87.0115	88.1509	88.5972	(217)
Fuel for water heating, kWh/month													
	247.8270	218.8550	230.8273	209.1338	208.1626	193.7301	185.6081	206.9096	208.4634	216.7197	226.3498	241.6352	(219)
Water heating fuel used												2594.2218	(219)
Annual totals kWh/year													
Space heating fuel - main system												5906.4918	(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)												502.4781	(232)
Total delivered energy for all uses												9078.1917	(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	5906.4918	0.2160	1275.8022	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.2218	0.2160	560.3519	(264)
Space and water heating			1836.1541	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	502.4781	0.5190	260.7861	(268)
Total CO2, kg/m2/year			2135.8653	(272)
Emissions per m2 for space and water heating			13.5680	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9270	(272b)
Emissions per m2 for pumps and fans			0.2876	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.5680 * 1.00) + 1.9270 + 0.2876, rounded to 2 d.p.			15.7800	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-04	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 4, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	88 B	**DER**	12.08	**TER**	14.02
Environmental	89 B	**% DER<TER**	13.84		
CO_2 Emissions (t/year)	1.50	**DFEE**	35.58	**TFEE**	43.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	19.13		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	150.9100 (1b)	x	2.6600 (2b)	=	401.4206	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	401.4206	(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) =	0.0996	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3496	(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) =	0.2972	(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	0.3789	0.3715	0.3641	0.3269	0.3195	0.2823	0.2823	0.2749	0.2972	0.3195	0.3343	0.3492	(22b)
Effective ac	0.5718	0.5690	0.5663	0.5534	0.5510	0.5399	0.5399	0.5378	0.5442	0.5510	0.5559	0.5610	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			17.6000	1.3258	23.3333			(27)
GF			45.0300	0.1400	6.3042	75.0000	3377.2500	(28a)
Main Type 3	75.7000	17.6000	58.1000	0.1700	9.8770	110.0000	6391.0000	(29a)
Corridor	6.4900	1.9500	4.5400	0.2257	1.0248	110.0000	499.4000	(29a)
Total net area of external elements Aum(A, m2)			127.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.8794			(33)
Party Wall 1			69.5300	0.0000	0.0000	20.0000	1390.6000	(32)
Party Floor 1			105.8800			40.0000	4235.2000	(32d)
Party Ceilings 1			150.9100			30.0000	4527.3000	(32b)
Internal Wall 1			248.9800			9.0000	2240.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22661.5700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.1661 (35)
Thermal bridges (User defined value 0.071 * total exposed area)		9.0326 (36)
Total fabric heat loss	(33) + (36) =	51.9120 (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	75.7448	75.3755	75.0135	73.3133	72.9952	71.5143	71.5143	71.2401	72.0847	72.9952	73.6387	74.3115	(38)
Heat transfer coeff	127.6568	127.2875	126.9255	125.2253	124.9071	123.4263	123.4263	123.1521	123.9967	124.9071	125.5507	126.2235	(39)
Average = Sum(39)m / 12 =												125.2237	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8459	0.8435	0.8411	0.8298	0.8277	0.8179	0.8179	0.8161	0.8217	0.8277	0.8320	0.8364	(40)
HLP (average)												0.8298	(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	2.9356 (42)
Average daily hot water use (litres/day)	103.9205 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3125	110.1557	105.9989	101.8421	97.6853	93.5284	93.5284	97.6853	101.8421	105.9989	110.1557	114.3125	(44)
Energy conte	169.5222	148.2652	152.9964	133.3860	127.9870	110.4431	102.3417	117.4386	118.8412	138.4980	151.1814	164.1732	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0739	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4283	22.2398	22.9495	20.0079	19.1981	16.5665	15.3513	17.6158	17.8262	20.7747	22.6772	24.6260	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740 (61)

Total heat required for water heating calculated for each month

	181.1962	158.8094	164.6704	144.6834	139.6610	121.7405	114.0157	129.1126	130.1386	150.1720	162.4788	175.8472 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

FGHRS	-57.5172	-47.4282	-43.7363	-30.6629	-21.1378	-7.9519	-7.3686	-8.4556	-8.5566	-31.3221	-44.5734	-57.4843 eq.(G2)
Output from w/h												
	123.6789	111.3813	120.9341	114.0204	118.5231	113.7886	106.6471	120.6570	121.5820	118.8498	117.9054	118.3629 (64)

Total per year (kWh/year) = Sum(64)m = 1406.3307 (64)

Heat gains from water heating, kWh/month

	59.2846	51.9342	53.7898	47.1752	45.4742	39.5467	36.9471	41.9668	42.3391	48.9691	53.0922	57.5061 (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	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	(66)

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

	32.0160	28.4363	23.1259	17.5078	13.0873	11.0489	11.9387	15.5183	20.8287	26.4468	30.8673	32.9058 (67)

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

	321.5107	324.8470	316.4397	298.5415	275.9483	254.7139	240.5280	237.1917	245.5990	263.4971	286.0904	307.3248 (68)

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

	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780 (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)

	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240 (71)

Water heating gains (Table 5)

	79.6836	77.2831	72.2981	65.5211	61.1212	54.9259	49.6601	56.4070	58.8042	65.8186	73.7391	77.2931 (72)

Total internal gains

	503.2443	500.6003	481.8977	451.6044	420.1908	390.7226	372.1607	379.1511	395.2659	425.7966	460.7308	487.5577 (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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)
West	7.2400	19.6403	0.6300	0.7000	0.7700	43.4568	(80)

Solar gains	77.1237	149.3499	249.3286	379.7913	486.7945	509.4041	480.3104	397.0662	294.2742	177.4598	95.7180	63.8032 (83)
Total gains	580.3680	649.9502	731.2263	831.3957	906.9852	900.1267	852.4711	776.2173	689.5401	603.2564	556.4488	551.3608 (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	49.3110	49.4540	49.5951	50.2685	50.3965	51.0011	51.0011	51.1147	50.7665	50.3965	50.1382	49.8709	
alpha	4.2874	4.2969	4.3063	4.3512	4.3598	4.4001	4.4001	4.4076	4.3844	4.3598	4.3425	4.3247	
util living area													
	0.9972	0.9951	0.9886	0.9655	0.8985	0.7581	0.6022	0.6697	0.8903	0.9808	0.9952	0.9978	(86)
MIT	19.4632	19.6111	19.8926	20.2916	20.6551	20.8927	20.9704	20.9534	20.7592	20.2963	19.8163	19.4418	(87)
Th 2	20.2137	20.2158	20.2179	20.2276	20.2294	20.2379	20.2379	20.2394	20.2346	20.2294	20.2257	20.2219	(88)
util rest of house													
	0.9967	0.9940	0.9860	0.9571	0.8725	0.6978	0.5114	0.5804	0.8519	0.9748	0.9940	0.9974	(89)
MIT 2	18.1078	18.3254	18.7373	19.3207	19.8301	20.1389	20.2188	20.2068	19.9817	19.3337	18.6326	18.0820	(90)
Living area fraction										fLA = Living area / (4) =		0.2168	(91)
MIT	18.4017	18.6042	18.9878	19.5312	20.0090	20.3023	20.3817	20.3687	20.1503	19.5424	18.8892	18.3768	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2517	18.4542	18.8378	19.3812	19.8590	20.1523	20.2317	20.2187	20.0003	19.3924	18.7392	18.2268	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9906	0.9796	0.9449	0.8575	0.6903	0.5106	0.5778	0.8376	0.9655	0.9906	0.9956	(94)
Useful gains	577.1633	643.8095	716.2891	785.6247	777.7722	621.3641	435.2836	448.4665	577.5321	582.4653	551.2144	548.9113	(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													
	1781.0268	1725.2781	1565.9830	1312.5141	1019.1164	685.2991	448.2511	470.2780	731.6183	1098.2378	1461.3151	1770.5154	(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													
	895.6745	726.7469	632.1723	379.3604	179.5601	0.0000	0.0000	0.0000	0.0000	383.7347	655.2724	908.8735	(98)
Space heating												4761.3949	(98)
Space heating per m2											(98) / (4) =	31.5512	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5308.1325	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	895.6745	726.7469	632.1723	379.3604	179.5601	0.0000	0.0000	0.0000	0.0000	383.7347	655.2724	908.8735	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	998.5223	810.1973	704.7629	422.9213	200.1785	0.0000	0.0000	0.0000	0.0000	427.7979	730.5155	1013.2369	(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													
	123.6789	111.3813	120.9341	114.0204	118.5231	113.7886	106.6471	120.6570	121.5820	118.8498	117.9054	118.3629	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3507	89.3175	89.2383	89.0370	88.5653	86.9000	86.9000	86.9000	86.9000	89.0217	89.2614	89.3682	(217)
Fuel for water heating, kWh/month													
	138.4197	124.7025	135.5182	128.0596	133.8257	130.9419	122.7239	138.8458	139.9103	133.5066	132.0900	132.4441	(219)
Water heating fuel used												1590.9883	(219)
Annual totals kWh/year													
Space heating fuel - main system												5308.1325	(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)												565.4117	(232)
Total delivered energy for all uses												7539.5325	(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	5308.1325	0.2160	1146.5566	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1590.9883	0.2160	343.6535	(264)
Space and water heating			1490.2101	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	565.4117	0.5190	293.4487	(268)
Total CO2, kg/year			1822.5838	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.0800	(273)

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

DER		12.0800	ZC1
Total Floor Area	TFA	150.9100	
Assumed number of occupants	N	2.9356	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6248	ZC2
CO2 emissions from cooking, equation (L16)		1.2554	ZC3
Total CO2 emissions		25.9602	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		25.9602	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	150.9100 (1b)	x	2.6600 (2b)	=	401.4206	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	401.4206	(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) =	0.0996	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3496	(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) =	0.2972	(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	0.3789	0.3715	0.3641	0.3269	0.3195	0.2823	0.2823	0.2749	0.2972	0.3195	0.3343	0.3492	(22b)
Effective ac	0.5718	0.5690	0.5663	0.5534	0.5510	0.5399	0.5399	0.5378	0.5442	0.5510	0.5559	0.5610	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			17.6000	1.3258	23.3333			(27)
GF			45.0300	0.1300	5.8539			(28a)
Main Type 3	75.7000	17.6000	58.1000	0.1800	10.4580			(29a)
Corridor	6.4900	1.9500	4.5400	0.1800	0.8172			(29a)
Total net area of external elements Aum(A, m2)			127.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.4124			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.3687	(36)
Total fabric heat loss (33) + (36) =	55.7811	(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	75.7448	75.3755	75.0135	73.3133	72.9952	71.5143	71.5143	71.2401	72.0847	72.9952	73.6387	74.3115	(38)
Heat transfer coeff	131.5259	131.1566	130.7947	129.0944	128.7763	127.2954	127.2954	127.0212	127.8658	128.7763	129.4198	130.0926	(39)
Average = Sum(39)m / 12 =												129.0929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8716	0.8691	0.8667	0.8554	0.8533	0.8435	0.8435	0.8417	0.8473	0.8533	0.8576	0.8621	(40)
HLP (average)												0.8554	(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	2.9356	(42)
Average daily hot water use (litres/day)	103.9205	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3125	110.1557	105.9989	101.8421	97.6853	93.5284	93.5284	97.6853	101.8421	105.9989	110.1557	114.3125	(44)
Energy conte	169.5222	148.2652	152.9964	133.3860	127.9870	110.4431	102.3417	117.4386	118.8412	138.4980	151.1814	164.1732	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0739	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4283	22.2398	22.9495	20.0079	19.1981	16.5665	15.3513	17.6158	17.8262	20.7747	22.6772	24.6260	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	49.7793	46.1236	47.6611	49.7793	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	220.4811	194.2926	203.9553	182.7010	177.7663	156.5667	150.0028	167.2180	168.1563	189.4569	200.4964	215.1321	(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													
	220.4811	194.2926	203.9553	182.7010	177.7663	156.5667	150.0028	167.2180	168.1563	189.4569	200.4964	215.1321	(64)
									Total per year (kWh/year) = Sum(64)m =			2226.2254	(64)
Heat gains from water heating, kWh/month													
	69.1059	60.8050	63.6110	56.6796	55.0005	48.2532	45.9439	51.4932	51.8435	58.7903	62.5966	67.3273	(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	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	32.0160	28.4363	23.1259	17.5078	13.0873	11.0489	11.9387	15.5183	20.8287	26.4468	30.8673	32.9058	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.5107	324.8470	316.4397	298.5415	275.9483	254.7139	240.5280	237.1917	245.5990	263.4971	286.0904	307.3248	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	(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)													
	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	(71)
Water heating gains (Table 5)													
	92.8842	90.4837	85.4987	78.7217	73.9254	67.0184	61.7525	69.2113	72.0048	79.0192	86.9397	90.4937	(72)
Total internal gains													
	516.4448	513.8009	495.0983	464.8050	432.9950	402.8151	384.2532	391.9553	408.4665	438.9972	473.9314	500.7582	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)
West	7.2400	19.6403	0.6300	0.7000	0.7700	43.4568	(80)

Solar gains	77.1237	149.3499	249.3286	379.7913	486.7945	509.4041	480.3104	397.0662	294.2742	177.4598	95.7180	63.8032	(83)
Total gains	593.5686	663.1508	744.4269	844.5963	919.7895	912.2191	864.5636	789.0215	702.7406	616.4570	569.6494	564.5614	(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	79.6790	79.9034	80.1245	81.1798	81.3804	82.3271	82.3271	82.5048	81.9598	81.3804	80.9757	80.5569	
alpha	6.3119	6.3269	6.3416	6.4120	6.4254	6.4885	6.4885	6.5003	6.4640	6.4254	6.3984	6.3705	
util living area													
	0.9998	0.9995	0.9984	0.9910	0.9505	0.8128	0.6336	0.7101	0.9428	0.9963	0.9996	0.9999	(86)
MIT	19.9491	20.0498	20.2432	20.5232	20.7873	20.9517	20.9919	20.9841	20.8553	20.5230	20.1918	19.9353	(87)
Th 2	20.1917	20.1938	20.1959	20.2055	20.2073	20.2158	20.2158	20.2173	20.2125	20.2073	20.2037	20.1999	(88)
util rest of house													
	0.9997	0.9994	0.9978	0.9871	0.9283	0.7421	0.5282	0.6043	0.9074	0.9943	0.9994	0.9998	(89)
MIT 2	18.7546	18.9036	19.1881	19.6028	19.9744	20.1792	20.2123	20.2095	20.0737	19.6058	19.1191	18.7406	(90)
Living area fraction									fLA = Living area / (4) =			0.2168	(91)
MIT	19.0136	19.1521	19.4169	19.8024	20.1507	20.3467	20.3813	20.3775	20.2431	19.8047	19.3516	18.9996	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0136	19.1521	19.4169	19.8024	20.1507	20.3467	20.3813	20.3775	20.2431	19.8047	19.3516	18.9996	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9991	0.9969	0.9845	0.9263	0.7550	0.5512	0.6272	0.9091	0.9928	0.9991	0.9997	(94)
Useful gains	593.3315	662.5426	742.1178	831.5186	852.0292	688.7382	476.5098	494.8352	638.8620	611.9896	569.1271	564.4004	(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													
	1935.2153	1869.2547	1689.4584	1407.4381	1088.2438	731.5269	481.3432	505.2228	785.4988	1185.3436	1585.6052	1925.3231	(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													
	998.3615	810.9106	704.8214	414.6620	175.7437	0.0000	0.0000	0.0000	0.0000	426.5754	731.8642	1012.5265	(98)
Space heating												5275.4653	(98)
Space heating per m2											(98) / (4) =	34.9577	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5648.2497	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	998.3615	810.9106	704.8214	414.6620	175.7437	0.0000	0.0000	0.0000	0.0000	426.5754	731.8642	1012.5265	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1068.9095	868.2126	754.6268	443.9636	188.1624	0.0000	0.0000	0.0000	0.0000	456.7188	783.5805	1084.0755	(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													
	220.4811	194.2926	203.9553	182.7010	177.7663	156.5667	150.0028	167.2180	168.1563	189.4569	200.4964	215.1321	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3889	88.2544	87.9182	87.0512	85.0224	80.3000	80.3000	80.3000	80.3000	87.0333	88.0193	88.4505	(217)
Fuel for water heating, kWh/month													
	249.4442	220.1505	231.9830	209.8776	209.0817	194.9772	186.8030	208.2415	209.4101	217.6831	227.7869	243.2233	(219)
Water heating fuel used												2608.6621	(219)
Annual totals kWh/year													
Space heating fuel - main system												5648.2497	(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)												565.4117	(232)
Total delivered energy for all uses												8897.3236	(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	5648.2497	0.2160	1220.0219	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2608.6621	0.2160	563.4710	(264)
Space and water heating			1783.4930	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	565.4117	0.5190	293.4487	(268)
Total CO2, kg/m2/year			2115.8666	(272)
Emissions per m2 for space and water heating			11.8183	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9445	(272b)
Emissions per m2 for pumps and fans			0.2579	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.8183 * 1.00) + 1.9445 + 0.2579, rounded to 2 d.p.			14.0200	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-05	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 5, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	87 B	**DER**	12.87	**TER**	14.76
Environmental	89 B	**% DER<TER**	12.83		
CO_2 Emissions (t/year)	1.10	**DFEE**	32.20	**TFEE**	37.79
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	104.7900 (1b)	x	2.6600 (2b)	=	278.7414	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	278.7414	(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) =	0.1435	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3178	0.3178	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			10.3600	1.3258	13.7348			(27)
Main Type 3	53.2000	10.3600	42.8400	0.1700	7.2828	110.0000	4712.4000	(29a)
Corridor	6.4900	1.9500	4.5400	0.2257	1.0248	110.0000	499.4000	(29a)
Total net area of external elements Aum(A, m2)			59.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.3825			(33)
Party Wall 1			54.6700	0.0000	0.0000	20.0000	1093.4000	(32)
Party Floor 1			104.7900			40.0000	4191.6000	(32d)
Party Ceilings 1			104.7900			30.0000	3143.7000	(32b)
Internal Wall 1			205.5500			9.0000	1849.9500	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15490.4500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8237 (35)
Thermal bridges (User defined value 0.100 * total exposed area)		5.9690 (36)
Total fabric heat loss	(33) + (36) =	30.3515 (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	54.3568	54.0320	53.7136	52.2182	51.9385	50.6360	50.6360	50.3948	51.1377	51.9385	52.5045	53.0962	(38)
Heat transfer coeff	84.7083	84.3835	84.0651	82.5697	82.2899	80.9875	80.9875	80.7463	81.4892	82.2899	82.8559	83.4477	(39)
Average = Sum(39)m / 12 =												82.5684	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8084	0.8053	0.8022	0.7880	0.7853	0.7729	0.7729	0.7706	0.7776	0.7853	0.7907	0.7963	(40)
HLP (average)												0.7879	(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	2.7797 (42)
Average daily hot water use (litres/day)	100.2170 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.2387	106.2300	102.2214	98.2127	94.2040	90.1953	90.1953	94.2040	98.2127	102.2214	106.2300	110.2387	(44)
Energy conte	163.4809	142.9814	147.5440	128.6324	123.4259	106.5071	98.6945	113.2534	114.6060	133.5623	145.7937	158.3225	(45)
Energy content (annual)										Total = Sum(45)m =		1576.8041	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5221	21.4472	22.1316	19.2949	18.5139	15.9761	14.8042	16.9880	17.1909	20.0343	21.8690	23.7484	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 11.6740 10.5442 11.6740 11.2974 11.6740 11.2974 11.6740 11.6740 11.2974 11.6740 11.2974 11.6740 (61)
Total heat required for water heating calculated for each month
175.1548 153.5256 159.2180 139.9298 135.0999 117.8045 110.3685 124.9274 125.9034 145.2362 157.0911 169.9965 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
FGHRS -41.0963 -34.7102 -32.8500 -24.4351 -16.6927 -7.6685 -7.1060 -8.1542 -8.2516 -24.2469 -32.5006 -40.8353 eq.(G2)
Output from w/h
134.0586 118.8155 126.3679 115.4947 118.4071 110.1360 103.2625 116.7731 117.6518 120.9893 124.5904 129.1612 (64)
Total per year (kWh/year) = Sum(64)m = 1435.7082 (64)
Heat gains from water heating, kWh/month
57.2759 50.1774 51.9769 45.5946 43.9576 38.2380 35.7344 40.5753 40.9309 47.3279 51.3007 55.5607 (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	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.2268	24.1826	19.6666	14.8889	11.1296	9.3961	10.1528	13.1970	17.7130	22.4907	26.2500	27.9835	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.8470	266.5850	259.6855	244.9974	226.4564	209.0304	197.3887	194.6508	201.5503	216.2384	234.7794	252.2054	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	(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)													
	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	(71)
Water heating gains (Table 5)													
	76.9837	74.6687	69.8614	63.3259	59.0828	53.1083	48.0301	54.5366	56.8484	63.6128	71.2510	74.6784	(72)
Total internal gains													
	435.7525	433.1312	416.9085	390.9071	364.3637	339.2297	323.2666	330.0794	343.8066	370.0368	399.9754	422.5622	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)

Solar gains	33.6669	64.3392	109.3280	175.6089	236.5612	253.2458	236.4373	187.5829	131.4477	76.5874	41.5325	28.0664	(83)
Total gains	469.4194	497.4704	526.2365	566.5160	600.9250	592.4755	559.7040	517.6623	475.2544	446.6243	441.5079	450.6286	(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	50.7967	50.9922	51.1854	52.1124	52.2895	53.1304	53.1304	53.2891	52.8034	52.2895	51.9323	51.5641	
alpha	4.3864	4.3995	4.4124	4.4742	4.4860	4.5420	4.5420	4.5526	4.5202	4.4860	4.4622	4.4376	
util living area													
	0.9947	0.9923	0.9859	0.9642	0.9012	0.7609	0.6043	0.6644	0.8803	0.9734	0.9914	0.9956	(86)
MIT	19.6182	19.7377	19.9773	20.3357	20.6715	20.9005	20.9733	20.9594	20.7883	20.3818	19.9535	19.6051	(87)
Th 2	20.2461	20.2488	20.2514	20.2638	20.2661	20.2769	20.2769	20.2789	20.2728	20.2661	20.2614	20.2565	(88)
util rest of house													
	0.9937	0.9908	0.9828	0.9558	0.8764	0.7032	0.5174	0.5792	0.8413	0.9656	0.9894	0.9947	(89)
MIT 2	18.3576	18.5339	18.8847	19.4111	19.8828	20.1838	20.2593	20.2500	20.0504	19.4831	18.8581	18.3456	(90)
Living area fraction									fLA = Living area / (4) =			0.2427	(91)
MIT	18.6635	18.8260	19.1499	19.6355	20.0742	20.3578	20.4325	20.4222	20.2294	19.7012	19.1239	18.6512	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5135	18.6760	18.9999	19.4855	19.9242	20.2078	20.2825	20.2722	20.0794	19.5512	18.9739	18.5012	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9862	0.9758	0.9443	0.8627	0.6971	0.5181	0.5783	0.8289	0.9554	0.9844	0.9917	(94)
Useful gains	464.7918	490.6004	513.5114	534.9337	518.4411	413.0435	290.0034	299.3858	393.9430	426.7094	434.6050	446.8867	(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													
	1204.0018	1162.4697	1050.8034	874.0419	676.7712	454.1586	298.2397	312.6648	487.2595	736.5932	983.8263	1193.4053	(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													
	549.9722	451.4962	399.7452	244.1580	117.7975	0.0000	0.0000	0.0000	0.0000	230.5536	395.4393	555.4099	(98)
Space heating												2944.5719	(98)
Space heating per m2											(98) / (4) =	28.0997	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3282.6889	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	549.9722	451.4962	399.7452	244.1580	117.7975	0.0000	0.0000	0.0000	0.0000	230.5536	395.4393	555.4099	(98)
Space heating efficiency (main heating system 1)	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)	613.1240	503.3402	445.6469	272.1939	131.3239	0.0000	0.0000	0.0000	0.0000	257.0274	440.8465	619.1860	(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	134.0586	118.8155	126.3679	115.4947	118.4071	110.1360	103.2625	116.7731	117.6518	120.9893	124.5904	129.1612	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.1371	89.1019	89.0111	88.7814	88.2742	86.9000	86.9000	86.9000	86.9000	88.7162	89.0129	89.1580	(217)
Fuel for water heating, kWh/month	150.3959	133.3479	141.9687	130.0889	134.1356	126.7388	118.8291	134.3765	135.3876	136.3780	139.9690	144.8678	(219)
Water heating fuel used												1626.4836	(219)
Annual totals kWh/year													
Space heating fuel - main system												3282.6889	(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)												480.8332	(232)
Total delivered energy for all uses												5465.0057	(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	3282.6889	0.2160	709.0608	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1626.4836	0.2160	351.3205	(264)
Space and water heating			1060.3813	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	480.8332	0.5190	249.5524	(268)
Total CO2, kg/year			1348.8587	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.8700	(273)

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

DER		12.8700	ZC1
Total Floor Area	TFA	104.7900	
Assumed number of occupants	N	2.7797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.9203	ZC2
CO2 emissions from cooking, equation (L16)		1.7722	ZC3
Total CO2 emissions		29.5626	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		29.5626	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	104.7900 (1b)	x	2.6600 (2b)	=	278.7414	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	278.7414	(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) =	0.1435	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3178	0.3178	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			10.3600	1.3258	13.7348			(27)
Main Type 3	53.2000	10.3600	42.8400	0.1800	7.7112			(29a)
Corridor	6.4900	1.9500	4.5400	0.1800	0.8172			(29a)
Total net area of external elements Aum(A, m2)			59.6900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.2132			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7469	(36)
Total fabric heat loss					(33) + (36) =		29.9601	(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	54.3568	54.0320	53.7136	52.2182	51.9385	50.6360	50.6360	50.3948	51.1377	51.9385	52.5045	53.0962	(38)
Heat transfer coeff	84.3169	83.9921	83.6738	82.1784	81.8986	80.5962	80.5962	80.3550	81.0979	81.8986	82.4646	83.0563	(39)
Average = Sum(39)m / 12 =												82.1771	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8046	0.8015	0.7985	0.7842	0.7815	0.7691	0.7691	0.7668	0.7739	0.7815	0.7870	0.7926	(40)
HLP (average)												0.7842	(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												2.7797	(42)
Average daily hot water use (litres/day)												100.2170	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.2387	106.2300	102.2214	98.2127	94.2040	90.1953	90.1953	94.2040	98.2127	102.2214	106.2300	110.2387	(44)
Energy conte	163.4809	142.9814	147.5440	128.6324	123.4259	106.5071	98.6945	113.2534	114.6060	133.5623	145.7937	158.3225	(45)
Energy content (annual)										Total = Sum(45)m =		1576.8041	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5221	21.4472	22.1316	19.2949	18.5139	15.9761	14.8042	16.9880	17.1909	20.0343	21.8690	23.7484	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.4337	48.0053	44.4799	45.9625	48.0053	48.4337	50.9589	49.3151	50.9589	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	214.4398	189.0088	198.5029	177.0661	171.4312	150.9870	144.6571	161.2587	163.0397	184.5212	195.1087	209.2814	(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													
	214.4398	189.0088	198.5029	177.0661	171.4312	150.9870	144.6571	161.2587	163.0397	184.5212	195.1087	209.2814	(64)
								Total per year (kWh/year) = Sum(64)m =				2159.3025	(64)
Heat gains from water heating, kWh/month													
	67.0971	59.0482	61.7981	54.8787	53.0404	46.5336	44.3066	49.6581	50.2149	57.1492	60.8052	65.3819	(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	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.2268	24.1826	19.6666	14.8889	11.1296	9.3961	10.1528	13.1970	17.7130	22.4907	26.2500	27.9835	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.8470	266.5850	259.6855	244.9974	226.4564	209.0304	197.3887	194.6508	201.5503	216.2384	234.7794	252.2054	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	(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)													
	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	(71)
Water heating gains (Table 5)													
	90.1843	87.8693	83.0620	76.2204	71.2909	64.6300	59.5518	66.7447	69.7429	76.8134	84.4516	87.8790	(72)
Total internal gains													
	448.9531	446.3318	430.1090	403.8017	376.5718	350.7514	334.7883	342.2875	356.7012	383.2374	413.1760	435.7628	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)

Solar gains	33.6669	64.3392	109.3280	175.6089	236.5612	253.2458	236.4373	187.5829	131.4477	76.5874	41.5325	28.0664	(83)
Total gains	482.6200	510.6710	539.4371	579.4106	613.1331	603.9972	571.2257	529.8704	488.1489	459.8249	454.7084	463.8292	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	86.3063	86.6401	86.9697	88.5523	88.8548	90.2907	90.2907	90.5617	89.7321	88.8548	88.2449	87.6162	
alpha	6.7538	6.7760	6.7980	6.9035	6.9237	7.0194	7.0194	7.0374	6.9821	6.9237	6.8830	6.8411	
util living area													
	0.9995	0.9992	0.9977	0.9898	0.9471	0.7966	0.6123	0.6799	0.9259	0.9935	0.9990	0.9996	(86)
MIT	20.1147	20.1942	20.3536	20.5959	20.8261	20.9666	20.9953	20.9910	20.8965	20.6206	20.3359	20.1069	(87)
Th 2	20.2493	20.2520	20.2546	20.2670	20.2694	20.2802	20.2802	20.2822	20.2760	20.2694	20.2647	20.2598	(88)
util rest of house													
	0.9994	0.9989	0.9969	0.9856	0.9245	0.7285	0.5167	0.5828	0.8857	0.9901	0.9985	0.9995	(89)
MIT 2	19.0412	19.1596	19.3948	19.7565	20.0795	20.2551	20.2781	20.2778	20.1794	19.7957	19.3769	19.0379	(90)
Living area fraction									fLA = Living area / (4) =			0.2427	(91)
MIT	19.3017	19.4107	19.6274	19.9602	20.2607	20.4278	20.4522	20.4508	20.3534	19.9959	19.6096	19.2973	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3017	19.4107	19.6274	19.9602	20.2607	20.4278	20.4522	20.4508	20.3534	19.9959	19.6096	19.2973	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9984	0.9959	0.9833	0.9242	0.7435	0.5401	0.6065	0.8908	0.9884	0.9980	0.9993	(94)
Useful gains	482.1743	509.8526	537.2450	569.7499	566.6664	449.0791	308.4943	321.3527	434.8264	454.4986	453.8023	463.5047	(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													
	1264.8962	1218.7851	1098.4231	908.9074	701.1060	469.6974	310.4717	325.5054	507.1413	769.5102	1031.6017	1253.9246	(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													
	582.3451	476.4026	417.5166	244.1934	100.0230	0.0000	0.0000	0.0000	0.0000	234.3686	416.0155	588.0724	(98)
Space heating												3058.9373	(98)
Space heating per m2											(98) / (4) =	29.1911	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3275.0934	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	582.3451	476.4026	417.5166	244.1934	100.0230	0.0000	0.0000	0.0000	0.0000	234.3686	416.0155	588.0724	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	623.4958	510.0670	447.0199	261.4490	107.0911	0.0000	0.0000	0.0000	0.0000	250.9300	445.4127	629.6278	(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													
	214.4398	189.0088	198.5029	177.0661	171.4312	150.9870	144.6571	161.2587	163.0397	184.5212	195.1087	209.2814	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.4401	87.2817	86.8788	85.8607	83.7477	80.3000	80.3000	80.3000	80.3000	85.6543	86.9100	87.5110	(217)
Fuel for water heating, kWh/month													
	245.2420	216.5504	228.4826	206.2248	204.6996	188.0287	180.1458	200.8204	203.0382	215.4255	224.4951	239.1487	(219)
Water heating fuel used												2552.3015	(219)
Annual totals kWh/year													
Space heating fuel - main system												3275.0934	(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)												480.8332	(232)
Total delivered energy for all uses												6383.2281	(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	3275.0934	0.2160	707.4202	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2552.3015	0.2160	551.2971	(264)
Space and water heating			1258.7173	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	480.8332	0.5190	249.5524	(268)
Total CO2, kg/m2/year			1547.1947	(272)
Emissions per m2 for space and water heating			12.0118	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3815	(272b)
Emissions per m2 for pumps and fans			0.3715	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0118 * 1.00) + 2.3815 + 0.3715, rounded to 2 d.p.			14.7600	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-06	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 6, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	87 B	**DER**	13.17	**TER**	14.98
Environmental	89 B	**% DER<TER**	12.11		
CO_2 Emissions (t/year)	1.25	**DFEE**	36.62	**TFEE**	42.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.72		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	114.8400 (1b)	x	2.6600 (2b)	=	305.4744	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.4744	(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) =	0.1309	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3809	(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) =	0.3238	(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	0.4128	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5663	0.5724	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			18.1000	1.3258	23.9962			(27)
Main Type 3	70.9700	18.1000	52.8700	0.1700	8.9879	110.0000	5815.7000	(29a)
Corridor	4.5200	1.9500	2.5700	0.2257	0.5801	110.0000	282.7000	(29a)
Total net area of external elements Aum(A, m2)			75.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.9042			(33)
Party Wall 1			56.0700	0.0000	0.0000	20.0000	1121.4000	(32)
Party Floor 1			114.8400			40.0000	4593.6000	(32d)
Party Ceilings 1			114.8400			30.0000	3445.2000	(32b)
Internal Wall 1			242.3800			9.0000	2181.4200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17440.0200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		151.8636 (35)
Thermal bridges (User defined value 0.114 * total exposed area)		8.6059 (36)
Total fabric heat loss	(33) + (36) =	44.5101 (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	58.9942	58.6606	58.3336	56.7977	56.5104	55.1727	55.1727	54.9250	55.6880	56.5104	57.0917	57.6994	(38)
Heat transfer coeff	103.5043	103.1707	102.8437	101.3078	101.0205	99.6828	99.6828	99.4351	100.1981	101.0205	101.6018	102.2095	(39)
Average = Sum(39)m / 12 =												101.3065	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9013	0.8984	0.8955	0.8822	0.8797	0.8680	0.8680	0.8659	0.8725	0.8797	0.8847	0.8900	(40)
HLP (average)												0.8822	(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		2.8410 (42)
Average daily hot water use (litres/day)		101.6729 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8402	107.7733	103.7064	99.6395	95.5725	91.5056	91.5056	95.5725	99.6395	103.7064	107.7733	111.8402	(44)
Energy conte	165.8558	145.0585	149.6874	130.5011	125.2189	108.0544	100.1283	114.8987	116.2709	135.5026	147.9117	160.6225	(45)
Energy content (annual)										Total = Sum(45)m =		1599.7109	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8784	21.7588	22.4531	19.5752	18.7828	16.2082	15.0192	17.2348	17.4406	20.3254	22.1867	24.0934	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss

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

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss 11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)

Total heat required for water heating calculated for each month

177.5298	155.6028	161.3614	141.7985	136.8929	119.3518	111.8023	126.5727	127.5683	147.1766	159.2091	172.2965	(62)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
							Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS -48.3129	-40.0710	-37.0330	-26.2665	-17.3282	-7.7799	-7.2092	-8.2727	-8.3715	-27.1097	-37.7649	-48.2024	eq.(G2)

Output from w/h

129.2169	115.5318	124.3284	115.5321	119.5647	111.5719	104.5930	118.3000	119.1968	120.0668	121.4441	124.0941	(64)
							Total per year (kWh/year) = Sum(64)m =				1423.4406	(64)

Heat gains from water heating, kWh/month

58.0655	50.8680	52.6896	46.2160	44.5538	38.7524	36.2112	41.1223	41.4844	47.9731	52.0050	56.3255	(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	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	(66)

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

25.9653	23.0621	18.7554	14.1990	10.6139	8.9607	9.6824	12.5855	16.8923	21.4487	25.0337	26.6869	(67)

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

278.3346	281.2229	273.9446	258.4500	238.8908	220.5080	208.2272	205.3389	212.6172	228.1118	247.6709	266.0538	(68)

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

37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	(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)

-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	(71)

Water heating gains (Table 5)

78.0451	75.6965	70.8193	64.1889	59.8841	53.8228	48.6709	55.2719	57.6173	64.4800	72.2291	75.7063	(72)

Total internal gains

450.9595	448.5959	432.1338	405.4524	378.0034	351.9061	335.1949	341.8109	355.7412	382.6549	413.5483	437.0615	(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	15.8900	10.6334	0.6300	0.7000	0.7700	51.6378	(74)
East	2.2100	19.6403	0.6300	0.7000	0.7700	13.2651	(76)

Solar gains 64.9029	124.6318	210.4205	331.6724	439.2171	466.6163	437.0857	351.6560	251.3149	148.2597	80.2419	53.9564	(83)
Total gains 515.8624	573.2278	642.5543	737.1248	817.2205	818.5223	772.2806	693.4669	607.0562	530.9146	493.7902	491.0179	(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	46.8043	46.9557	47.1050	47.8191	47.9551	48.5987	48.5987	48.7197	48.3487	47.9551	47.6807	47.3972	
alpha	4.1203	4.1304	4.1403	4.1879	4.1970	4.2399	4.2399	4.2480	4.2232	4.1970	4.1787	4.1598	
util living area	0.9952	0.9919	0.9823	0.9490	0.8594	0.6974	0.5444	0.6164	0.8572	0.9710	0.9919	0.9961	(86)
MIT	19.4578	19.6124	19.9067	20.3284	20.6971	20.9140	20.9767	20.9616	20.7812	20.3167	19.8238	19.4365	(87)
Th 2	20.1664	20.1689	20.1713	20.1827	20.1848	20.1948	20.1948	20.1966	20.1909	20.1848	20.1805	20.1760	(88)
util rest of house	0.9942	0.9902	0.9784	0.9370	0.8263	0.6321	0.4542	0.5249	0.8107	0.9621	0.9899	0.9953	(89)
MIT 2	18.0671	18.2942	18.7240	19.3373	19.8447	20.1191	20.1806	20.1712	19.9695	19.3292	18.6114	18.0423	(90)
Living area fraction									fLA = Living area / (4) =			0.3265	(91)
MIT	18.5211	18.7245	19.1101	19.6608	20.1230	20.3786	20.4405	20.4292	20.2345	19.6516	19.0072	18.4975	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3711	18.5745	18.9601	19.5108	19.9730	20.2286	20.2905	20.2792	20.0845	19.5016	18.8572	18.3475	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9910	0.9855	0.9705	0.9246	0.8165	0.6350	0.4654	0.5348	0.8035	0.9520	0.9852	0.9926	(94)
Useful gains	511.2114	564.8982	623.6271	681.5623	667.2780	519.7793	359.4051	370.8787	487.7948	505.4508	486.4923	487.3760	(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	1456.4182	1410.8084	1281.4443	1074.9594	835.7420	561.0746	367.8816	385.7300	599.6327	899.2406	1194.5490	1446.0049	(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	703.2339	568.4517	489.4160	283.2459	125.3372	0.0000	0.0000	0.0000	0.0000	292.9796	509.8008	713.2199	(98)
Space heating												3685.6849	(98)
Space heating per m2											(98) / (4) =	32.0941	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4108.9018	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	703.2339	568.4517	489.4160	283.2459	125.3372	0.0000	0.0000	0.0000	0.0000	292.9796	509.8008	713.2199	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	783.9842	633.7254	545.6142	315.7702	139.7294	0.0000	0.0000	0.0000	0.0000	326.6216	568.3398	795.1169	(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													
	129.2169	115.5318	124.3284	115.5321	119.5647	111.5719	104.5930	118.3000	119.1968	120.0668	121.4441	124.0941	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.2536	89.2145	89.1183	88.8704	88.3108	86.9000	86.9000	86.9000	86.9000	88.8676	89.1474	89.2737	(217)
Fuel for water heating, kWh/month													
	144.7750	129.4989	139.5093	130.0006	135.3908	128.3911	120.3602	136.1334	137.1655	135.1075	136.2285	139.0041	(219)
Water heating fuel used												1611.5651	(219)
Annual totals kWh/year													
Space heating fuel - main system												4108.9018	(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)												458.5552	(232)
Total delivered energy for all uses												6254.0221	(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	4108.9018	0.2160	887.5228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1611.5651	0.2160	348.0981	(264)
Space and water heating			1235.6209	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	458.5552	0.5190	237.9901	(268)
Total CO2, kg/year			1512.5360	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.1700	(273)

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

DER		13.1700	ZC1
Total Floor Area	TFA	114.8400	
Assumed number of occupants	N	2.8410	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3622	ZC2
CO2 emissions from cooking, equation (L16)		1.6299	ZC3
Total CO2 emissions		29.1621	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		29.1621	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	114.8400 (1b)	x	2.6600 (2b)	=	305.4744	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.4744	(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) =	0.1309	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3809	(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) =	0.3238	(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	0.4128	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5663	0.5724	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			18.1000	1.3258	23.9962			(27)
Main Type 3	70.9700	18.1000	52.8700	0.1800	9.5166			(29a)
Corridor	4.5200	1.9500	2.5700	0.1800	0.4626			(29a)
Total net area of external elements Aum(A, m2)			75.4900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.9254			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.1617	(36)
Total fabric heat loss (33) + (36) =	44.0871	(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	58.9942	58.6606	58.3336	56.7977	56.5104	55.1727	55.1727	54.9250	55.6880	56.5104	57.0917	57.6994	(38)
Heat transfer coeff	103.0813	102.7477	102.4207	100.8848	100.5975	99.2598	99.2598	99.0121	99.7751	100.5975	101.1788	101.7865	(39)
Average = Sum(39)m / 12 =												100.8835	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8976	0.8947	0.8919	0.8785	0.8760	0.8643	0.8643	0.8622	0.8688	0.8760	0.8810	0.8863	(40)
HLP (average)												0.8785	(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	2.8410	(42)
Average daily hot water use (litres/day)	101.6729	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8402	107.7733	103.7064	99.6395	95.5725	91.5056	91.5056	95.5725	99.6395	103.7064	107.7733	111.8402	(44)
Energy conte	165.8558	145.0585	149.6874	130.5011	125.2189	108.0544	100.1283	114.8987	116.2709	135.5026	147.9117	160.6225	(45)
Energy content (annual)										Total = Sum(45)m =		1599.7109	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8784	21.7588	22.4531	19.5752	18.7828	16.2082	15.0192	17.2348	17.4406	20.3254	22.1867	24.0934	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.1373	48.7027	45.1261	46.6303	48.7027	49.1373	50.9589	49.3151	50.9589	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	216.8147	191.0859	200.6463	179.6384	173.9217	153.1805	146.7586	163.6014	165.4082	186.4615	197.2267	211.5814	(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													
	216.8147	191.0859	200.6463	179.6384	173.9217	153.1805	146.7586	163.6014	165.4082	186.4615	197.2267	211.5814	(64)
								Total per year (kWh/year) = Sum(64)m =				2186.3253	(64)
Heat gains from water heating, kWh/month													
	67.8868	59.7388	62.5108	55.6759	53.8110	47.2096	44.9502	50.3795	50.9444	57.7943	61.5094	66.1467	(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	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9653	23.0621	18.7554	14.1990	10.6139	8.9607	9.6824	12.5855	16.8923	21.4487	25.0337	26.6869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	278.3346	281.2229	273.9446	258.4500	238.8908	220.5080	208.2272	205.3389	212.6172	228.1118	247.6709	266.0538	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	(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)													
	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	(71)
Water heating gains (Table 5)													
	91.2457	88.8970	84.0199	77.3277	72.3266	65.5689	60.4170	67.7144	70.7561	77.6806	85.4297	88.9069	(72)
Total internal gains													
	464.1601	461.7965	445.3343	418.5912	390.4459	363.6521	346.9410	354.2533	368.8801	395.8555	426.7489	450.2620	(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	15.8900	10.6334	0.6300	0.7000	0.7700	51.6378	(74)
East	2.2100	19.6403	0.6300	0.7000	0.7700	13.2651	(76)

Solar gains	64.9029	124.6318	210.4205	331.6724	439.2171	466.6163	437.0857	351.6560	251.3149	148.2597	80.2419	53.9564	(83)
Total gains	529.0630	586.4284	655.7549	750.2637	829.6630	830.2684	784.0267	705.9094	620.1950	544.1152	506.9908	504.2184	(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	77.3661	77.6173	77.8651	79.0505	79.2763	80.3447	80.3447	80.5457	79.9298	79.2763	78.8209	78.3502	
alpha	6.1577	6.1745	6.1910	6.2700	6.2851	6.3563	6.3563	6.3697	6.3287	6.2851	6.2547	6.2233	
util living area													
	0.9995	0.9989	0.9964	0.9812	0.9088	0.7270	0.5510	0.6306	0.9042	0.9920	0.9989	0.9996	(86)
MIT	19.9777	20.0836	20.2863	20.5831	20.8437	20.9727	20.9959	20.9911	20.8900	20.5641	20.2261	19.9640	(87)
Th 2	20.1695	20.1720	20.1744	20.1858	20.1880	20.1979	20.1979	20.1998	20.1941	20.1880	20.1836	20.1791	(88)
util rest of house													
	0.9994	0.9986	0.9951	0.9738	0.8748	0.6511	0.4538	0.5284	0.8549	0.9879	0.9985	0.9995	(89)
MIT 2	18.7795	18.9364	19.2343	19.6717	20.0265	20.1788	20.1963	20.1957	20.0958	19.6496	19.1539	18.7668	(90)
Living area fraction									fLA = Living area / (4) =			0.3265	(91)
MIT	19.1707	19.3109	19.5777	19.9693	20.2933	20.4380	20.4573	20.4554	20.3551	19.9482	19.5039	19.1576	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1707	19.3109	19.5777	19.9693	20.2933	20.4380	20.4573	20.4554	20.3551	19.9482	19.5039	19.1576	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9980	0.9938	0.9713	0.8798	0.6749	0.4857	0.5620	0.8662	0.9862	0.9979	0.9993	(94)
Useful gains	528.5675	585.2640	651.7099	728.7330	729.9392	560.3210	380.8066	396.6938	537.2398	536.6154	505.9467	503.8707	(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													
	1532.8869	1480.6908	1339.4306	1116.7222	864.4634	579.4798	382.8754	401.5294	624.0987	940.4019	1255.0166	1522.4868	(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													
	747.2136	601.7268	511.6642	279.3522	100.0860	0.0000	0.0000	0.0000	0.0000	300.4172	539.3303	757.8504	(98)
Space heating												3837.6407	(98)
Space heating per m2											(98) / (4) =	33.4173	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4108.8230	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	747.2136	601.7268	511.6642	279.3522	100.0860	0.0000	0.0000	0.0000	0.0000	300.4172	539.3303	757.8504	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	800.0146	644.2471	547.8203	299.0923	107.1585	0.0000	0.0000	0.0000	0.0000	321.6458	577.4414	811.4030	(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													
	216.8147	191.0859	200.6463	179.6384	173.9217	153.1805	146.7586	163.6014	165.4082	186.4615	197.2267	211.5814	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9131	87.7401	87.3067	86.1587	83.7164	80.3000	80.3000	80.3000	80.3000	86.2456	87.4546	87.9847	(217)
Fuel for water heating, kWh/month													
	246.6239	217.7863	229.8177	208.4971	207.7509	190.7603	182.7629	203.7378	205.9878	216.1983	225.5191	240.4752	(219)
Water heating fuel used												2575.9172	(219)
Annual totals kWh/year													
Space heating fuel - main system												4108.8230	(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)												458.5552	(232)
Total delivered energy for all uses												7218.2953	(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	4108.8230	0.2160	887.5058	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2575.9172	0.2160	556.3981	(264)
Space and water heating			1443.9039	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	458.5552	0.5190	237.9901	(268)
Total CO2, kg/m2/year			1720.8190	(272)
Emissions per m2 for space and water heating			12.5732	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0724	(272b)
Emissions per m2 for pumps and fans			0.3389	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5732 * 1.00) + 2.0724 + 0.3389, rounded to 2 d.p.			14.9800	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-07	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT GF
Property	Plot 7, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	87 B	**DER**	13.74	**TER**	15.11
Environmental	88 B	**% DER<TER**	9.08		
CO_2 Emissions (t/year)	1.33	**DFEE**	38.40	**TFEE**	43.82
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.35		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	120.9900 (1b)	x	2.6600 (2b)	=	321.8334	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	120.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	321.8334	(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) =	0.1243	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3743	(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) =	0.3181	(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	0.4056	0.3977	0.3897	0.3500	0.3420	0.3022	0.3022	0.2943	0.3181	0.3420	0.3579	0.3738	(22b)
Effective ac	0.5823	0.5791	0.5759	0.5612	0.5585	0.5457	0.5457	0.5433	0.5506	0.5585	0.5641	0.5699	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			12.1600	1.3258	16.1212			(27)
GF			76.7200	0.1200	9.2064	75.0000	5754.0000	(28a)
Main Type 3	66.2200	12.1600	54.0600	0.1700	9.1902	110.0000	5946.6000	(29a)
Corridor	24.4600	1.9500	22.5100	0.2257	5.0813	110.0000	2476.1000	(29a)
Total net area of external elements Aum(A, m2)			167.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9391			(33)
Party Wall 1			38.4000	0.0000	0.0000	20.0000	768.0000	(32)
Party Floor 1			44.2700			40.0000	1770.8000	(32d)
Party Ceilings 1			120.9900			30.0000	3629.7000	(32b)
Internal Wall 1			223.5500			75.0000	16766.2500	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	37111.4500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		306.7315 (35)
Thermal bridges (User defined value 0.073 * total exposed area)		12.2202 (36)
Total fabric heat loss	(33) + (36) =	54.1593 (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	61.8400	61.5007	61.1681	59.6061	59.3138	57.9533	57.9533	57.7013	58.4773	59.3138	59.9050	60.5231	(38)
Heat transfer coeff	115.9992	115.6600	115.3274	113.7653	113.4731	112.1126	112.1126	111.8606	112.6366	113.4731	114.0643	114.6824	(39)
Average = Sum(39)m / 12 =												113.7639	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9588	0.9559	0.9532	0.9403	0.9379	0.9266	0.9266	0.9245	0.9310	0.9379	0.9428	0.9479	(40)
HLP (average)												0.9403	(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	2.8671 (42)
Average daily hot water use (litres/day)	102.2927 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5219	108.4302	104.3385	100.2468	96.1551	92.0634	92.0634	96.1551	100.2468	104.3385	108.4302	112.5219	(44)
Energy conte	166.8668	145.9427	150.5998	131.2966	125.9822	108.7131	100.7386	115.5991	116.9797	136.3285	148.8133	161.6016	(45)
Energy content (annual)										Total = Sum(45)m =		1609.4619	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0300	21.8914	22.5900	19.6945	18.8973	16.3070	15.1108	17.3399	17.5470	20.4493	22.3220	24.2402	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740 (61)

Total heat required for water heating calculated for each month

	178.5408	156.4870	162.2738	142.5940	137.6562	120.0105	112.4126	127.2730	128.2771	148.0025	160.1107	173.2755 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

FGHRS	-53.9258	-43.5042	-39.6064	-27.8950	-18.2346	-7.8273	-7.2532	-8.3231	-8.4225	-27.3537	-41.0415	-54.1238 eq.(G2)

Output from w/h

	124.6149	112.9828	122.6675	114.6989	119.4216	112.1831	105.1594	118.9499	119.8545	120.6488	119.0691	119.1518 (64)

Total per year (kWh/year) = Sum(64)m = 1409.4024 (64)

Heat gains from water heating, kWh/month

	58.4017	51.1620	52.9929	46.4805	44.8076	38.9714	36.4141	41.3552	41.7201	48.2477	52.3048	56.6510 (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	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	(66)

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

	29.4620	26.1679	21.2812	16.1112	12.0433	10.1675	10.9863	14.2804	19.1672	24.3371	28.4050	30.2809 (67)

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

	286.4964	289.4694	281.9777	266.0287	245.8960	226.9742	214.3332	211.3602	218.8519	234.8009	254.9336	273.8555 (68)

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

	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353 (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)

	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824 (71)

Water heating gains (Table 5)

	78.4969	76.1340	71.2271	64.5562	60.2252	54.1270	48.9437	55.5849	57.9446	64.8491	72.6455	76.1438 (72)

Total internal gains

	463.4613	460.7772	443.4918	415.7020	387.1705	360.2745	343.2691	350.2315	364.9696	392.9930	424.9900	449.2861 (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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	7.7400	46.7521	0.6300	0.7000	0.7700	110.5894	(78)

Solar gains	137.1197	233.0158	316.1808	385.4062	424.4879	417.8786	404.3800	376.0112	340.4098	256.9340	164.1663	117.3766 (83)
Total gains	600.5810	693.7929	759.6727	801.1083	811.6584	778.1531	747.6491	726.2427	705.3794	649.9270	589.1563	566.6627 (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	88.8690	89.1297	89.3867	90.6140	90.8474	91.9499	91.9499	92.1570	91.5221	90.8474	90.3765	89.8894	
alpha	6.9246	6.9420	6.9591	7.0409	7.0565	7.1300	7.1300	7.1438	7.1015	7.0565	7.0251	6.9926	
util living area	0.9998	0.9993	0.9977	0.9906	0.9588	0.8386	0.6478	0.6898	0.9147	0.9933	0.9994	0.9999	(86)
MIT	20.0934	20.2070	20.3794	20.6035	20.8115	20.9557	20.9939	20.9907	20.9101	20.6363	20.3223	20.0760	(87)
Th 2	20.1178	20.1202	20.1225	20.1334	20.1354	20.1449	20.1449	20.1467	20.1413	20.1354	20.1313	20.1270	(88)
util rest of house	0.9997	0.9991	0.9967	0.9857	0.9354	0.7603	0.5288	0.5722	0.8602	0.9889	0.9991	0.9998	(89)
MIT 2	18.8917	19.0596	19.3134	19.6469	19.9381	20.1149	20.1429	20.1432	20.0678	19.6976	19.2373	18.8733	(90)

Living area fraction fLA = Living area / (4) = 0.2324 (91)

MIT	19.1710	19.3263	19.5611	19.8693	20.1411	20.3103	20.3407	20.3401	20.2635	19.9158	19.4894	19.1528	(92)

Temperature adjustment -0.1500

adjusted MIT	19.0210	19.1763	19.4111	19.7193	19.9911	20.1603	20.1907	20.1901	20.1135	19.7658	19.3394	19.0028	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9986	0.9954	0.9825	0.9304	0.7619	0.5354	0.5785	0.8581	0.9861	0.9987	0.9997	(94)
Useful gains	600.3005	692.8138	756.2151	787.0668	755.1609	592.8407	400.2935	420.1464	605.2694	640.8893	588.3612	566.4869	(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	1707.6212	1651.1965	1489.0065	1230.8566	940.8183	623.3833	402.5575	423.9681	677.3441	1040.0661	1396.0835	1697.6213	(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	823.8466	644.0332	545.1968	319.5286	138.1291	0.0000	0.0000	0.0000	0.0000	296.9875	581.5601	841.5640	(98)

Space heating 4190.8460 (98)

Space heating per m2 (98) / (4) = 34.6380 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4672.0691	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	823.8466	644.0332	545.1968	319.5286	138.1291	0.0000	0.0000	0.0000	0.0000	296.9875	581.5601	841.5640	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	918.4467	717.9857	607.8002	356.2192	153.9901	0.0000	0.0000	0.0000	0.0000	331.0898	648.3390	938.1984	(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													
	124.6149	112.9828	122.6675	114.6989	119.4216	112.1831	105.1594	118.9499	119.8545	120.6488	119.0691	119.1518	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3219	89.2707	89.1723	88.9430	88.3796	86.9000	86.9000	86.9000	86.9000	88.8728	89.2115	89.3430	(217)
Fuel for water heating, kWh/month													
	139.5122	126.5620	137.5623	128.9578	135.1235	129.0945	121.0120	136.8814	137.9224	135.7545	133.4684	133.3645	(219)
Water heating fuel used												1595.2155	(219)
Annual totals kWh/year													
Space heating fuel - main system												4672.0691	(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)												520.3087	(232)
Total delivered energy for all uses												6862.5933	(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	4672.0691	0.2160	1009.1669	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1595.2155	0.2160	344.5666	(264)
Space and water heating			1353.7335	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	520.3087	0.5190	270.0402	(268)
Total CO2, kg/year			1662.6987	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7400	(273)

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

DER		13.7400	ZC1
Total Floor Area	TFA	120.9900	
Assumed number of occupants	N	2.8671	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.0319	ZC2
CO2 emissions from cooking, equation (L16)		1.5523	ZC3
Total CO2 emissions		29.3242	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		29.3242	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	120.9900 (1b)	x	2.6600 (2b)	=	321.8334	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	120.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	321.8334	(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) =	0.1243	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3743	(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) =	0.3181	(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	0.4056	0.3977	0.3897	0.3500	0.3420	0.3022	0.3022	0.2943	0.3181	0.3420	0.3579	0.3738	(22b)
Effective ac	0.5823	0.5791	0.5759	0.5612	0.5585	0.5457	0.5457	0.5433	0.5506	0.5585	0.5641	0.5699	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			12.1600	1.3258	16.1212			(27)
GF			76.7200	0.1300	9.9736			(28a)
Main Type 3	66.2200	12.1600	54.0600	0.1800	9.7308			(29a)
Corridor	24.4600	1.9500	22.5100	0.1800	4.0518			(29a)
Total net area of external elements Aum(A, m2)			167.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.8274			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.2652	(36)
Total fabric heat loss (33) + (36) =	54.0926	(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	61.8400	61.5007	61.1681	59.6061	59.3138	57.9533	57.9533	57.7013	58.4773	59.3138	59.9050	60.5231	(38)
Heat transfer coeff	115.9326	115.5933	115.2607	113.6987	113.4064	112.0459	112.0459	111.7940	112.5700	113.4064	113.9976	114.6157	(39)
Average = Sum(39)m / 12 =												113.6973	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9582	0.9554	0.9526	0.9397	0.9373	0.9261	0.9261	0.9240	0.9304	0.9373	0.9422	0.9473	(40)
HLP (average)												0.9397	(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	2.8671	(42)
Average daily hot water use (litres/day)	102.2927	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5219	108.4302	104.3385	100.2468	96.1551	92.0634	92.0634	96.1551	100.2468	104.3385	108.4302	112.5219	(44)
Energy conte	166.8668	145.9427	150.5998	131.2966	125.9822	108.7131	100.7386	115.5991	116.9797	136.3285	148.8133	161.6016	(45)
Energy content (annual)										Total = Sum(45)m =		1609.4619	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0300	21.8914	22.5900	19.6945	18.8973	16.3070	15.1108	17.3399	17.5470	20.4493	22.3220	24.2402	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	48.9996	45.4011	46.9145	48.9996	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	217.8257	191.9701	201.5587	180.6117	174.9818	154.1142	147.6531	164.5986	166.2947	187.2874	198.1283	212.5605	(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													
	217.8257	191.9701	201.5587	180.6117	174.9818	154.1142	147.6531	164.5986	166.2947	187.2874	198.1283	212.5605	(64)
									Total per year (kWh/year) = Sum(64)m =			2197.5850	(64)
Heat gains from water heating, kWh/month													
	68.2229	60.0328	62.8142	55.9849	54.1390	47.4974	45.2242	50.6866	51.2245	58.0690	61.8092	66.4722	(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	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.4620	26.1679	21.2812	16.1112	12.0433	10.1675	10.9863	14.2804	19.1672	24.3371	28.4050	30.2809	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	286.4964	289.4694	281.9777	266.0287	245.8960	226.9742	214.3332	211.3602	218.8519	234.8009	254.9336	273.8555	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	(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)													
	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	(71)
Water heating gains (Table 5)													
	91.6975	89.3345	84.4277	77.7568	72.7674	65.9686	60.7852	68.1271	71.1452	78.0497	85.8461	89.3444	(72)
Total internal gains													
	476.6619	473.9777	456.6924	428.9026	399.7127	372.1161	355.1106	362.7737	378.1702	406.1936	438.1906	462.4867	(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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	7.7400	46.7521	0.6300	0.7000	0.7700	110.5894	(78)

Solar gains	137.1197	233.0158	316.1808	385.4062	424.4879	417.8786	404.3800	376.0112	340.4098	256.9340	164.1663	117.3766	(83)
Total gains	613.7815	706.9935	772.8732	814.3088	824.2006	789.9947	759.4907	738.7849	718.5800	663.1276	602.3569	579.8633	(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	72.4739	72.6866	72.8963	73.8978	74.0883	74.9879	74.9879	75.1569	74.6388	74.0883	73.7040	73.3065	
alpha	5.8316	5.8458	5.8598	5.9265	5.9392	5.9992	5.9992	6.0105	5.9759	5.9392	5.9136	5.8871	
util living area													
	0.9992	0.9978	0.9941	0.9813	0.9383	0.8125	0.6312	0.6701	0.8877	0.9854	0.9980	0.9994	(86)
MIT	19.9360	20.0700	20.2730	20.5345	20.7728	20.9391	20.9890	20.9844	20.8878	20.5753	20.2066	19.9151	(87)
Th 2	20.1183	20.1207	20.1230	20.1339	20.1359	20.1454	20.1454	20.1472	20.1417	20.1359	20.1318	20.1275	(88)
util rest of house													
	0.9989	0.9971	0.9920	0.9737	0.9114	0.7377	0.5179	0.5588	0.8321	0.9781	0.9971	0.9992	(89)
MIT 2	18.6802	18.8778	19.1754	19.5612	19.8928	20.0997	20.1407	20.1399	20.0444	19.6240	19.0861	18.6564	(90)
Living area fraction									fLA = Living area / (4) =			0.2324	(91)
MIT	18.9721	19.1549	19.4305	19.7874	20.0973	20.2948	20.3379	20.3362	20.2404	19.8451	19.3465	18.9490	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9721	19.1549	19.4305	19.7874	20.0973	20.2948	20.3379	20.3362	20.2404	19.8451	19.3465	18.9490	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9959	0.9896	0.9697	0.9099	0.7521	0.5444	0.5846	0.8395	0.9748	0.9960	0.9988	(94)
Useful gains	612.7524	704.1153	764.8503	789.6704	749.9447	594.1487	413.4467	431.9250	603.2493	646.3885	599.9738	579.1626	(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													
	1700.9696	1647.7692	1490.3760	1237.8855	952.3109	638.0746	418.8151	440.0426	691.2220	1048.4496	1396.0733	1690.4638	(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													
	809.6336	634.1354	539.7911	322.7148	150.5605	0.0000	0.0000	0.0000	0.0000	299.1335	573.1916	826.8081	(98)
Space heating												4155.9687	(98)
Space heating per m2											(98) / (4) =	34.3497	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4449.6452	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	809.6336	634.1354	539.7911	322.7148	150.5605	0.0000	0.0000	0.0000	0.0000	299.1335	573.1916	826.8081	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	866.8454	678.9458	577.9348	345.5191	161.1997	0.0000	0.0000	0.0000	0.0000	320.2714	613.6955	885.2335	(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													
	217.8257	191.9701	201.5587	180.6117	174.9818	154.1142	147.6531	164.5986	166.2947	187.2874	198.1283	212.5605	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0520	87.8328	87.4108	86.4961	84.6754	80.3000	80.3000	80.3000	80.3000	86.2243	87.5707	88.1330	(217)
Fuel for water heating, kWh/month													
	247.3829	218.5632	230.5878	208.8090	206.6502	191.9230	183.8769	204.9796	207.0918	217.2096	226.2495	241.1815	(219)
Water heating fuel used												2584.5052	(219)
Annual totals kWh/year													
Space heating fuel - main system												4449.6452	(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)												520.3087	(232)
Total delivered energy for all uses												7629.4591	(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	4449.6452	0.2160	961.1234	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2584.5052	0.2160	558.2531	(264)
Space and water heating			1519.3765	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	520.3087	0.5190	270.0402	(268)
Total CO2, kg/m2/year			1828.3417	(272)
Emissions per m2 for space and water heating			12.5579	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2319	(272b)
Emissions per m2 for pumps and fans			0.3217	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5579 * 1.00) + 2.2319 + 0.3217, rounded to 2 d.p.			15.1100	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-08	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 8, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	13.75	**TER**	14.65
Environmental	88 B	**% DER<TER**	6.14		
CO_2 Emissions (t/year)	1.51	**DFEE**	42.45	**TFEE**	45.21
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.10		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	131.1900 (1b)	x	2.6500 (2b)	=	347.6535	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	347.6535	(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) =	0.1151	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3651	(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) =	0.3103	(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	0.3956	0.3879	0.3801	0.3413	0.3336	0.2948	0.2948	0.2870	0.3103	0.3336	0.3491	0.3646	(22b)
Effective ac	0.5783	0.5752	0.5722	0.5583	0.5556	0.5434	0.5434	0.5412	0.5481	0.5556	0.5609	0.5665	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			16.6900	1.3258	22.1269			(27)
Velux (Uw = 1.40)			1.9200	1.3258	2.5455			(27a)
Main Type 3	110.8300	16.6900	94.1400	0.1700	16.0038	110.0000	10355.4000	(29a)
Corridor	3.2500	1.9500	1.3000	0.2257	0.2935	110.0000	143.0000	(29a)
PIJ	25.0600		25.0600	0.1800	4.5108	9.0000	225.5400	(30)
PIR	22.2200	1.9200	20.3000	0.1800	3.6540	9.0000	182.7000	(30)
Total net area of external elements Aum(A, m2)			161.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.4744			(33)
Party Wall 1			24.8500	0.0000	0.0000	20.0000	497.0000	(32)
Party Floor 1			131.1900			40.0000	5247.6000	(32d)
Party Ceilings 1			90.8100			30.0000	2724.3000	(32b)
Internal Wall 1			230.3700			9.0000	2073.3300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21448.8700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.4947 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		24.2040 (36)
Total fabric heat loss	(33) + (36) =	75.6784 (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	66.3415	65.9928	65.6511	64.0459	63.7456	62.3475	62.3475	62.0886	62.8860	63.7456	64.3531	64.9883	(38)
Heat transfer coeff	142.0199	141.6712	141.3295	139.7243	139.4240	138.0259	138.0259	137.7670	138.5644	139.4240	140.0315	140.6667	(39)
Average = Sum(39)m / 12 =												139.7229	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0826	1.0799	1.0773	1.0651	1.0628	1.0521	1.0521	1.0501	1.0562	1.0628	1.0674	1.0722	(40)
HLP (average)												1.0650	(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	2.8980 (42)
Average daily hot water use (litres/day)	103.0277 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3305	109.2094	105.0883	100.9672	96.8461	92.7250	92.7250	96.8461	100.9672	105.0883	109.2094	113.3305	(44)
Energy conte	168.0659	146.9915	151.6820	132.2401	126.8875	109.4943	101.4625	116.4297	117.8203	137.3082	149.8826	162.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1621.0274	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
              25.2099    22.0487    22.7523    19.8360    19.0331    16.4241    15.2194    17.4645    17.6730    20.5962    22.4824    24.4144 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     11.6740    10.5442    11.6740    11.2974    11.6740    11.2974    11.6740    11.6740    11.2974    11.6740    11.2974    11.6740 (61)
Total heat required for water heating calculated for each month
             179.7398   157.5357   163.3560   143.5375   138.5615   120.7917   113.1365   128.1037   129.1177   148.9822   161.1800   174.4368 (62)
Solar input    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                Solar input (sum of months) = Sum(63)m =      0.0000 (63)
FGHRS        -59.6821   -47.8362   -42.9330   -29.5408   -19.9630    -7.8836    -7.3053    -8.3829    -8.4831   -30.4050   -45.4897   -60.0253 eq.(G2)
Output from w/h
             120.0578   109.6995   120.4230   113.9967   118.5985   112.9081   105.8312   119.7208   120.6346   118.5772   115.6903   114.4114 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =   1390.5491 (64)
Heat gains from water heating, kWh/month
              58.8004    51.5107    53.3528    46.7942    45.1086    39.2312    36.6548    41.6314    41.9996    48.5735    52.6603    57.0371 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m       144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005   144.9005 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              28.4015    25.2260    20.5152    15.5313    11.6098     9.8015    10.5909    13.7664    18.4772    23.4611    27.3826    29.1909 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             299.1491   302.2534   294.4308   277.7775   256.7557   236.9981   223.7989   220.6946   228.5172   245.1705   266.1923   285.9499 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900    37.4900 (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)
            -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204  -115.9204 (71)
Water heating gains (Table 5)
              79.0328    76.6529    71.7107    64.9919    60.6298    54.4878    49.2672    55.9562    58.3328    65.2869    73.1393    76.6628 (72)
Total internal gains
             476.0536   473.6024   456.1268   427.7708   398.4655   370.7575   353.1271   359.8873   374.7974   403.3887   436.1844   461.2737 (73)
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6. Solar gains

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[Jan]                                        Area          Solar flux              g                FF            Access            Gains
                                             m2            Table 6a      Specific data      Specific data      factor                W
                                                             W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
East                                       4.4200           19.6403            0.6300             0.7000          0.7700           26.5303 (76)
South                                      5.9400           46.7521            0.6300             0.7000          0.7700           84.8710 (78)
West                                       6.3300           19.6403            0.6300             0.7000          0.7700           37.9947 (80)
North                                      0.9600           16.7973            0.7400             0.7000          1.0000            7.5177 (82)
South                                      0.9600           42.0754            0.7400             0.7000          1.0000           18.8309 (82)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains   175.7445   314.4153   464.9260   625.6754   739.8635   750.0295   716.7738   630.3120   520.9736   357.3684   213.3711   148.4746 (83)
Total gains   651.7980   788.0176   921.0528  1053.4462  1138.3289  1120.7870  1069.9009   990.1994   895.7709   760.7571   649.5555   609.7483 (84)
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7. Mean internal temperature (heating season)

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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          41.9520    42.0553    42.1570    42.6413    42.7331    43.1659    43.1659    43.2471    42.9982    42.7331    42.5477    42.3556
alpha         3.7968     3.8037     3.8105     3.8428     3.8489     3.8777     3.8777     3.8831     3.8665     3.8489     3.8365     3.8237
util living area
              0.9946     0.9884     0.9733     0.9319     0.8420     0.6916     0.5385     0.5941     0.8196     0.9585     0.9901     0.9958 (86)

MIT          19.2724    19.4934    19.8429    20.2862    20.6593    20.8907    20.9685    20.9540    20.7760    20.2738    19.6885    19.2352 (87)
Th 2          20.0151    20.0173    20.0194    20.0295    20.0314    20.0401    20.0401    20.0418    20.0368    20.0314    20.0275    20.0236 (88)
util rest of house
              0.9934     0.9858     0.9669     0.9149     0.8017     0.6154     0.4330     0.4882     0.7594     0.9448     0.9873     0.9949 (89)
MIT 2        17.6890    18.0121    18.5197    19.1575    19.6640    19.9497    20.0231    20.0146    19.8263    19.1517    18.3047    17.6400 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1643 (91)
MIT          17.9491    18.2554    18.7371    19.3429    19.8275    20.1043    20.1784    20.1690    19.9823    19.3360    18.5320    17.9020 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT 17.7991    18.1054    18.5871    19.1929    19.6775    19.9543    20.0284    20.0190    19.8323    19.1860    18.3820    17.7520 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9890     0.9781     0.9539     0.8961     0.7845     0.6080     0.4317     0.4855     0.7443     0.9284     0.9803     0.9913 (94)
Useful gains 644.6007   770.7332   878.5490   944.0165   892.9838   681.4007   461.8331   480.7076   666.6795   706.2732   636.7417   604.4196 (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
            1917.1416  1870.8292  1708.2574  1438.1650  1112.2511   739.0326   473.2040   498.5719   794.2923  1197.0909  1579.8402  1906.3217 (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
             946.7704   739.2645   617.3030   355.7869   163.1349     0.0000     0.0000     0.0000     0.0000   365.1684   679.0309   968.6151 (98)
Space heating                                                                                                                 4835.0743 (98)
Space heating per m2                                                                                          (98) / (4) =     36.8555 (99)
```

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5390.2723	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	946.7704	739.2645	617.3030	355.7869	163.1349	0.0000	0.0000	0.0000	0.0000	365.1684	679.0309	968.6151	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1055.4854	824.1522	688.1862	396.6409	181.8672	0.0000	0.0000	0.0000	0.0000	407.0997	757.0021	1079.8385	(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													
	120.0578	109.6995	120.4230	113.9967	118.5985	112.9081	105.8312	119.7208	120.6346	118.5772	115.6903	114.4114	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3759	89.3281	89.2307	89.0041	88.4996	86.9000	86.9000	86.9000	86.9000	88.9971	89.2812	89.3957	(217)
Fuel for water heating, kWh/month													
	134.3290	122.8051	134.9569	128.0802	134.0102	129.9287	121.7851	137.7684	138.8200	133.2372	129.5797	127.9831	(219)
Water heating fuel used												1573.2838	(219)
Annual totals kWh/year													
Space heating fuel - main system												5390.2723	(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)												501.5799	(232)
Total delivered energy for all uses												7540.1360	(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	5390.2723	0.2160	1164.2988	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1573.2838	0.2160	339.8293	(264)
Space and water heating			1504.1281	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	501.5799	0.5190	260.3200	(268)
Total CO2, kg/year			1803.3731	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7500	(273)

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

DER		13.7500	ZC1
Total Floor Area	TFA	131.1900	
Assumed number of occupants	N	2.8980	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5124	ZC2
CO2 emissions from cooking, equation (L16)		1.4372	ZC3
Total CO2 emissions		28.6997	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		28.6997	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	131.1900 (1b)	x	2.6500 (2b)	=	347.6535	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	347.6535	(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) =	0.1151	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3651	(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) =	0.3103	(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	0.3956	0.3879	0.3801	0.3413	0.3336	0.2948	0.2948	0.2870	0.3103	0.3336	0.3491	0.3646	(22b)
Effective ac	0.5783	0.5752	0.5722	0.5583	0.5556	0.5434	0.5434	0.5412	0.5481	0.5556	0.5609	0.5665	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			16.6900	1.3258	22.1269			(27)
TER Room Window (Uw = 1.70)			1.9200	1.5918	3.0562			(27a)
Main Type 3	110.8300	16.6900	94.1400	0.1800	16.9452			(29a)
Corridor	3.2500	1.9500	1.3000	0.1800	0.2340			(29a)
PIJ	25.0600		25.0600	0.1300	3.2578			(30)
PIR	22.2200	1.9200	20.3000	0.1300	2.6390			(30)
Total net area of external elements Aum(A, m2)			161.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.2091			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.7972	(36)
Total fabric heat loss (33) + (36) =	66.0063	(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	66.3415	65.9928	65.6511	64.0459	63.7456	62.3475	62.3475	62.0886	62.8860	63.7456	64.3531	64.9883	(38)
Heat transfer coeff	132.3477	131.9991	131.6573	130.0522	129.7518	128.3538	128.3538	128.0949	128.8923	129.7518	130.3594	130.9946	(39)
Average = Sum(39)m / 12 =												130.0507	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0088	1.0062	1.0036	0.9913	0.9890	0.9784	0.9784	0.9764	0.9825	0.9890	0.9937	0.9985	(40)
HLP (average)												0.9913	(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	2.8980	(42)
Average daily hot water use (litres/day)	103.0277	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3305	109.2094	105.0883	100.9672	96.8461	92.7250	92.7250	96.8461	100.9672	105.0883	109.2094	113.3305	(44)
Energy conte	168.0659	146.9915	151.6820	132.2401	126.8875	109.4943	101.4625	116.4297	117.8203	137.3082	149.8826	162.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1621.0274	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2099	22.0487	22.7523	19.8360	19.0331	16.4241	15.2194	17.4645	17.6730	20.5962	22.4824	24.4144	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.3517	45.7274	47.2516	49.3517	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	219.0248	193.0189	202.6409	181.5551	176.2392	155.2216	148.7142	165.7814	167.1353	188.2671	199.1977	213.7217	(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													
	219.0248	193.0189	202.6409	181.5551	176.2392	155.2216	148.7142	165.7814	167.1353	188.2671	199.1977	213.7217	(64)
								Total per year (kWh/year) = Sum(64)m =				2210.5180	(64)
Heat gains from water heating, kWh/month													
	68.6216	60.3815	63.1740	56.2986	54.5280	47.8387	45.5492	51.0508	51.5040	58.3947	62.1647	66.8584	(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	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.4015	25.2260	20.5152	15.5313	11.6098	9.8015	10.5909	13.7664	18.4772	23.4611	27.3826	29.1909	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.1491	302.2534	294.4308	277.7775	256.7557	236.9981	223.7989	220.6946	228.5172	245.1705	266.1923	285.9499	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	(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)													
	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	(71)
Water heating gains (Table 5)													
	92.2334	89.8534	84.9113	78.1925	73.2903	66.4426	61.2220	68.6167	71.5333	78.4875	86.3399	89.8634	(72)
Total internal gains													
	489.2542	486.8029	469.3274	440.9714	411.1260	382.7124	365.0819	372.5479	387.9979	416.5893	449.3850	474.4743	(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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	5.9400	46.7521	0.6300	0.7000	0.7700	84.8710	(78)
West	6.3300	19.6403	0.6300	0.7000	0.7700	37.9947	(80)
North	0.9600	16.7973	0.6300	0.7000	1.0000	6.4002	(82)
South	0.9600	42.0754	0.6300	0.7000	1.0000	16.0317	(82)

Solar gains	171.8278	307.1026	453.0349	607.4821	716.1116	724.9076	693.1995	611.1586	506.9633	348.7957	208.5675	145.1930	(83)
Total gains	661.0819	793.9056	922.3623	1048.4535	1127.2376	1107.6200	1058.2814	983.7065	894.9613	765.3849	657.9525	619.6673	(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	68.8370	69.0188	69.1979	70.0520	70.2142	70.9790	70.9790	71.1224	70.6824	70.2142	69.8869	69.5481	
alpha	5.5891	5.6013	5.6132	5.6701	5.6809	5.7319	5.7319	5.7415	5.7122	5.6809	5.6591	5.6365	
util living area													
	0.9992	0.9975	0.9912	0.9642	0.8777	0.7018	0.5268	0.5859	0.8483	0.9823	0.9979	0.9994	(86)
MIT	19.8613	20.0199	20.2684	20.5852	20.8397	20.9674	20.9946	20.9905	20.9039	20.5593	20.1486	19.8358	(87)
Th 2	20.0760	20.0782	20.0804	20.0906	20.0925	20.1014	20.1014	20.1030	20.0980	20.0925	20.0886	20.0846	(88)
util rest of house													
	0.9989	0.9966	0.9881	0.9509	0.8352	0.6191	0.4229	0.4784	0.7823	0.9735	0.9971	0.9992	(89)
MIT 2	18.5397	18.7729	19.1361	19.5957	19.9332	20.0793	20.0993	20.0990	20.0191	19.5669	18.9693	18.5086	(90)
Living area fraction									fLA = Living area / (4) =			0.1643	(91)
MIT	18.7568	18.9777	19.3221	19.7582	20.0821	20.2252	20.2464	20.2454	20.1644	19.7299	19.1630	18.7266	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7568	18.9777	19.3221	19.7582	20.0821	20.2252	20.2464	20.2454	20.1644	19.7299	19.1630	18.7266	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9951	0.9845	0.9448	0.8347	0.6312	0.4399	0.4960	0.7879	0.9687	0.9958	0.9988	(94)
Useful gains	659.9417	790.0098	908.0348	990.6197	940.8882	699.1017	465.5862	487.8986	705.1434	741.4407	655.1811	618.9177	(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													
	1913.3214	1858.2480	1688.1171	1412.1377	1087.5973	722.0171	468.0268	492.5785	781.6589	1184.6260	1572.5262	1902.9064	(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													
	932.5145	717.8561	580.3813	303.4929	109.1516	0.0000	0.0000	0.0000	0.0000	329.7299	660.4885	955.2876	(98)
Space heating												4588.9023	(98)
Space heating per m2											(98) / (4) =	34.9791	(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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4913.1717	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	932.5145	717.8561	580.3813	303.4929	109.1516	0.0000	0.0000	0.0000	0.0000	329.7299	660.4885	955.2876	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	998.4095	768.5825	621.3932	324.9389	116.8646	0.0000	0.0000	0.0000	0.0000	353.0298	707.1611	1022.7919	(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													
	219.0248	193.0189	202.6409	181.5551	176.2392	155.2216	148.7142	165.7814	167.1353	188.2671	199.1977	213.7217	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2879	88.0531	87.5502	86.3354	83.8845	80.3000	80.3000	80.3000	80.3000	86.4481	87.8400	88.3680	(217)
Fuel for water heating, kWh/month													
	248.0803	219.2073	231.4569	210.2905	210.0975	193.3022	185.1982	206.4526	208.1387	217.7805	226.7734	241.8543	(219)
Water heating fuel used												2598.6323	(219)
Annual totals kWh/year													
Space heating fuel - main system												4913.1717	(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)												501.5799	(232)
Total delivered energy for all uses												8088.3838	(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	4913.1717	0.2160	1061.2451	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2598.6323	0.2160	561.3046	(264)
Space and water heating			1622.5497	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	501.5799	0.5190	260.3200	(268)
Total CO2, kg/m2/year			1921.7946	(272)
Emissions per m2 for space and water heating			12.3679	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9843	(272b)
Emissions per m2 for pumps and fans			0.2967	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.3679 * 1.00) + 1.9843 + 0.2967, rounded to 2 d.p.			14.6500	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-09	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 9, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	88 B	**DER**	11.70	**TER**	13.20
Environmental	89 B	**% DER<TER**	11.37		
CO_2 Emissions (t/year)	1.41	**DFEE**	33.45	**TFEE**	38.73
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.65		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	144.4200 (1b)	x	2.6500 (2b)	=	382.7130	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	144.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	382.7130	(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) =	0.1045	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3545	(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) =	0.3013	(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	0.3842	0.3767	0.3691	0.3315	0.3239	0.2863	0.2863	0.2787	0.3013	0.3239	0.3390	0.3541	(22b)
Effective ac	0.5738	0.5709	0.5681	0.5549	0.5525	0.5410	0.5410	0.5388	0.5454	0.5525	0.5575	0.5627	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			15.6900	1.3258	20.8011			(27)
Main Type 3	63.4700	15.6900	47.7800	0.1700	8.1226	110.0000	5255.8000	(29a)
Corridor	6.6800	1.7200	4.9600	0.2257	1.1196	110.0000	545.6000	(29a)
PIJ	39.7100		39.7100	0.1600	6.3536	9.0000	357.3900	(30)
Total net area of external elements Aum(A, m2)			109.8600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4610			(33)
Party Wall 1			65.1600	0.0000	0.0000	20.0000	1303.2000	(32)
Party Floor 1			144.7200			40.0000	5788.8000	(32d)
Party Ceilings 1			104.7200			30.0000	3141.6000	(32b)
Internal Wall 1			253.8700			9.0000	2284.8300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18677.2200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	129.3257	(35)
Thermal bridges (User defined value 0.150 * total exposed area)	16.4790	(36)
Total fabric heat loss	(33) + (36) = 54.9400	(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	72.4692	72.1073	71.7525	70.0860	69.7742	68.3227	68.3227	68.0539	68.8818	69.7742	70.4049	71.0644	(38)
Heat transfer coeff	127.4092	127.0472	126.6924	125.0259	124.7141	123.2627	123.2627	122.9939	123.8218	124.7141	125.3449	126.0043	(39)
Average = Sum(39)m / 12 =												125.0244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8822	0.8797	0.8772	0.8657	0.8636	0.8535	0.8535	0.8516	0.8574	0.8636	0.8679	0.8725	(40)
HLP (average)												0.8657	(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	2.9251	(42)
Average daily hot water use (litres/day)	103.6704	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.0374	109.8906	105.7438	101.5970	97.4502	93.3033	93.3033	97.4502	101.5970	105.7438	109.8906	114.0374	(44)
Energy conte	169.1142	147.9084	152.6282	133.0649	127.6790	110.1772	102.0954	117.1560	118.5552	138.1647	150.8175	163.7781	(45)
Energy content (annual)										Total = Sum(45)m =		1631.1387	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3671	22.1863	22.8942	19.9597	19.1518	16.5266	15.3143	17.5734	17.7833	20.7247	22.6226	24.5667	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)

Total heat required for water heating calculated for each month

	180.7882	158.4526	164.3021	144.3623	139.3530	121.4746	113.7694	128.8300	129.8526	149.8386	162.1149	175.4520	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-53.6033	-43.1373	-39.4628	-28.5151	-20.5817	-7.9328	-7.3509	-8.4352	-8.5360	-27.9586	-40.9462	-53.8641	eq.(G2)
Output from w/h													
	127.1849	115.3153	124.8394	115.8472	118.7712	113.5419	106.4185	120.3947	121.3166	121.8801	121.1687	121.5880	(64)
									Total per year (kWh/year) = Sum(64)m =			1428.2666	(64)

Heat gains from water heating, kWh/month

	59.1490	51.8156	53.6674	47.0684	45.3718	39.4583	36.8652	41.8729	42.2440	48.8582	52.9712	57.3747	(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	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	(66)

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

	31.7959	28.2408	22.9670	17.3875	12.9973	10.9729	11.8566	15.4117	20.6855	26.2650	30.6552	32.6796	(67)

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

	314.3839	317.6462	309.4253	291.9239	269.8315	249.0677	235.1963	231.9340	240.1549	257.6563	279.7487	300.5125	(68)

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

	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	(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)

	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	(71)

Water heating gains (Table 5)

	79.5013	77.1065	72.1336	65.3728	60.9835	54.8032	49.5500	56.2807	58.6722	65.6697	73.5711	77.1165	(72)

Total internal gains

	495.5571	492.8696	474.4019	444.5602	413.6884	384.7199	366.4790	373.5024	389.3886	419.4671	453.8510	480.1846	(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	
South	10.3600	46.7521	0.6300	0.7000	0.7700	148.0241	(78)
West	5.3300	19.6403	0.6300	0.7000	0.7700	31.9924	(80)

Solar gains	180.0164	305.0092	411.8735	499.3354	547.9178	538.5915	521.5184	486.3310	442.4560	335.7394	215.3497	154.2154	(83)
Total gains	675.5736	797.8788	886.2754	943.8956	961.6062	923.3114	887.9974	859.8334	831.8446	755.2065	669.2007	634.4000	(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	40.7201	40.8361	40.9505	41.4963	41.6001	42.0899	42.0899	42.1819	41.8999	41.6001	41.3907	41.1741	
alpha	3.7147	3.7224	3.7300	3.7664	3.7733	3.8060	3.8060	3.8121	3.7933	3.7733	3.7594	3.7449	
util living area													
	0.9903	0.9814	0.9647	0.9289	0.8575	0.7256	0.5706	0.6053	0.8018	0.9413	0.9829	0.9923	(86)
MIT	19.3348	19.5577	19.8771	20.2700	20.6150	20.8630	20.9589	20.9478	20.7844	20.3268	19.7562	19.2967	(87)
Th 2	20.1826	20.1848	20.1869	20.1967	20.1986	20.2072	20.2072	20.2088	20.2039	20.1986	20.1949	20.1910	(88)
util rest of house													
	0.9886	0.9782	0.9583	0.9148	0.8271	0.6654	0.4821	0.5189	0.7519	0.9270	0.9794	0.9909	(89)
MIT 2	17.9158	18.2413	18.7052	19.2741	19.7537	20.0776	20.1793	20.1712	19.9842	19.3626	18.5387	17.8658	(90)
Living area fraction									fLA = Living area / (4) =			0.2109	(91)
MIT	18.2151	18.5189	18.9524	19.4842	19.9353	20.2432	20.3437	20.3350	20.1529	19.5660	18.7955	18.1676	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0651	18.3689	18.8024	19.3342	19.7853	20.0932	20.1937	20.1850	20.0029	19.4160	18.6455	18.0176	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9820	0.9679	0.9436	0.8961	0.8088	0.6558	0.4805	0.5162	0.7374	0.9089	0.9696	0.9854	(94)
Useful gains	663.4328	772.3053	836.2623	845.7785	777.7860	605.5245	426.6607	443.8132	613.4099	686.4427	648.8798	625.1274	(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													
	1753.8003	1711.1896	1558.6186	1304.5410	1008.3525	677.1088	442.9697	465.5331	730.9129	1099.4738	1447.1707	1741.0750	(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													
	811.2335	630.9302	537.4331	330.3090	171.5415	0.0000	0.0000	0.0000	0.0000	307.2951	574.7694	830.2651	(98)
Space heating												4193.7770	(98)
Space heating per m2											(98) / (4) =	29.0388	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4675.3366	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	811.2335	630.9302	537.4331	330.3090	171.5415	0.0000	0.0000	0.0000	0.0000	307.2951	574.7694	830.2651	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	904.3851	703.3782	599.1451	368.2375	191.2391	0.0000	0.0000	0.0000	0.0000	342.5809	640.7686	925.6021	(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													
	127.1849	115.3153	124.8394	115.8472	118.7712	113.5419	106.4185	120.3947	121.3166	121.8801	121.1687	121.5880	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3100	89.2556	89.1585	88.9558	88.5330	86.9000	86.9000	86.9000	86.9000	88.8867	89.1996	89.3323	(217)
Fuel for water heating, kWh/month													
	142.4084	129.1967	140.0196	130.2302	134.1548	130.6581	122.4609	138.5440	139.6049	137.1185	135.8400	136.1075	(219)
Water heating fuel used												1616.3436	(219)
Annual totals kWh/year													
Space heating fuel - main system												4675.3366	(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)												561.5252	(232)
Total delivered energy for all uses												6928.2054	(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	4675.3366	0.2160	1009.8727	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1616.3436	0.2160	349.1302	(264)
Space and water heating			1359.0029	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	561.5252	0.5190	291.4316	(268)
Total CO2, kg/year			1689.3595	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.7000	(273)

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

DER		11.7000	ZC1
Total Floor Area	TFA	144.4200	
Assumed number of occupants	N	2.9251	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.8997	ZC2
CO2 emissions from cooking, equation (L16)		1.3101	ZC3
Total CO2 emissions		25.9098	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		25.9098	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	144.4200 (1b)	x	2.6500 (2b)	=	382.7130	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	144.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	382.7130	(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) =	0.1045	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3545	(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) =	0.3013	(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	0.3842	0.3767	0.3691	0.3315	0.3239	0.2863	0.2863	0.2787	0.3013	0.3239	0.3390	0.3541	(22b)
Effective ac	0.5738	0.5709	0.5681	0.5549	0.5525	0.5410	0.5410	0.5388	0.5454	0.5525	0.5575	0.5627	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			15.6900	1.3258	20.8011			(27)
Main Type 3	63.4700	15.6900	47.7800	0.1800	8.6004			(29a)
Corridor	6.6800	1.7200	4.9600	0.1800	0.8928			(29a)
PIJ	39.7100		39.7100	0.1300	5.1623			(30)
Total net area of external elements Aum(A, m2)			109.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.1766			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.4825	(36)
Total fabric heat loss					(33) + (36) =		53.6591	(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	72.4692	72.1073	71.7525	70.0860	69.7742	68.3227	68.3227	68.0539	68.8818	69.7742	70.4049	71.0644	(38)
Heat transfer coeff	126.1284	125.7664	125.4116	123.7451	123.4333	121.9819	121.9819	121.7131	122.5409	123.4333	124.0641	124.7235	(39)
Average = Sum(39)m / 12 =												123.7436	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8733	0.8708	0.8684	0.8568	0.8547	0.8446	0.8446	0.8428	0.8485	0.8547	0.8591	0.8636	(40)
HLP (average)												0.8568	(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												2.9251	(42)
Average daily hot water use (litres/day)												103.6704	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.0374	109.8906	105.7438	101.5970	97.4502	93.3033	93.3033	97.4502	101.5970	105.7438	109.8906	114.0374	(44)
Energy conte	169.1142	147.9084	152.6282	133.0649	127.6790	110.1772	102.0954	117.1560	118.5552	138.1647	150.8175	163.7781	(45)
Energy content (annual)										Total = Sum(45)m =		1631.1387	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3671	22.1863	22.8942	19.9597	19.1518	16.5266	15.3143	17.5734	17.7833	20.7247	22.6226	24.5667	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.3151	49.6595	46.0126	47.5464	49.6595	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	220.0731	193.9357	203.5871	182.3800	177.3385	156.1899	149.6418	166.8155	167.8703	189.1236	200.1326	214.7370	(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													
	220.0731	193.9357	203.5871	182.3800	177.3385	156.1899	149.6418	166.8155	167.8703	189.1236	200.1326	214.7370	(64)
									Total per year (kWh/year) = Sum(64)m =			2221.8249	(64)
Heat gains from water heating, kWh/month													
	68.9702	60.6864	63.4886	56.5729	54.8681	48.1371	45.8333	51.3692	51.7484	58.6795	62.4756	67.1959	(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	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	31.7959	28.2408	22.9670	17.3875	12.9973	10.9729	11.8566	15.4117	20.6855	26.2650	30.6552	32.6796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	314.3839	317.6462	309.4253	291.9239	269.8315	249.0677	235.1963	231.9340	240.1549	257.6563	279.7487	300.5125	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	37.6253	(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)													
	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	-117.0027	(71)
Water heating gains (Table 5)													
	92.7019	90.3071	85.3341	78.5734	73.7475	66.8571	61.6039	69.0447	71.8727	78.8703	86.7717	90.3171	(72)
Total internal gains													
	508.7577	506.0702	487.6024	457.7608	426.4524	396.7737	378.5329	386.2664	402.5892	432.6676	467.0516	493.3852	(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	
South	10.3600	46.7521	0.6300	0.7000	0.7700	148.0241	(78)
West	5.3300	19.6403	0.6300	0.7000	0.7700	31.9924	(80)

Solar gains	180.0164	305.0092	411.8735	499.3354	547.9178	538.5915	521.5184	486.3310	442.4560	335.7394	215.3497	154.2154	(83)
Total gains	688.7742	811.0794	899.4760	957.0962	974.3702	935.3653	900.0512	872.5974	845.0452	768.4071	682.4013	647.6006	(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	79.5156	79.7444	79.9700	81.0470	81.2517	82.2185	82.2185	82.4001	81.8434	81.2517	80.8386	80.4112	
alpha	6.3010	6.3163	6.3313	6.4031	6.4168	6.4812	6.4812	6.4933	6.4562	6.4168	6.3892	6.3607	
util living area													
	0.9994	0.9981	0.9941	0.9787	0.9249	0.7769	0.5877	0.6283	0.8661	0.9848	0.9984	0.9996	(86)
MIT	20.0290	20.1674	20.3664	20.6149	20.8305	20.9628	20.9947	20.9920	20.9218	20.6378	20.2837	20.0065	(87)
Th 2	20.1902	20.1924	20.1945	20.2043	20.2062	20.2148	20.2148	20.2164	20.2115	20.2062	20.2024	20.1985	(88)
util rest of house													
	0.9992	0.9975	0.9920	0.9704	0.8952	0.7034	0.4874	0.5281	0.8084	0.9773	0.9977	0.9995	(89)
MIT 2	18.8703	19.0743	19.3660	19.7314	20.0274	20.1876	20.2126	20.2127	20.1452	19.7686	19.2523	18.8438	(90)
Living area fraction									fLA = Living area / (4) =			0.2109	(91)
MIT	19.1147	19.3048	19.5770	19.9177	20.1967	20.3511	20.3775	20.3771	20.3090	19.9519	19.4698	19.0891	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1147	19.3048	19.5770	19.9177	20.1967	20.3511	20.3775	20.3771	20.3090	19.9519	19.4698	19.0891	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9965	0.9898	0.9666	0.8948	0.7171	0.5087	0.5493	0.8164	0.9742	0.9969	0.9992	(94)
Useful gains	687.9658	808.2739	890.3040	925.1739	871.8788	670.7793	457.8366	479.3085	689.9250	748.5726	680.2591	647.0816	(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													
	1868.5508	1811.6437	1640.0110	1363.3865	1048.7802	701.5346	460.7903	484.0626	760.8539	1154.3379	1534.6528	1857.0160	(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													
	878.3552	674.2645	557.7820	315.5131	131.6146	0.0000	0.0000	0.0000	0.0000	301.8894	615.1635	900.1912	(98)
Space heating												4374.7735	(98)
Space heating per m2											(98) / (4) =	30.2920	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4683.9117	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	878.3552	674.2645	557.7820	315.5131	131.6146	0.0000	0.0000	0.0000	0.0000	301.8894	615.1635	900.1912	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	940.4232	721.9106	597.1970	337.8084	140.9150	0.0000	0.0000	0.0000	0.0000	323.2221	658.6332	963.8022	(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													
	220.0731	193.9357	203.5871	182.3800	177.3385	156.1899	149.6418	166.8155	167.8703	189.1236	200.1326	214.7370	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1779	87.9295	87.4585	86.4184	84.3129	80.3000	80.3000	80.3000	80.3000	86.2228	87.6925	88.2618	(217)
Fuel for water heating, kWh/month													
	249.5785	220.5581	232.7812	211.0429	210.3338	194.5079	186.3534	207.7404	209.0539	219.3428	228.2209	243.2953	(219)
Water heating fuel used												2612.8091	(219)
Annual totals kWh/year													
Space heating fuel - main system												4683.9117	(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)												561.5252	(232)
Total delivered energy for all uses												7933.2461	(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	4683.9117	0.2160	1011.7249	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2612.8091	0.2160	564.3668	(264)
Space and water heating			1576.0917	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	561.5252	0.5190	291.4316	(268)
Total CO2, kg/m2/year			1906.4483	(272)
Emissions per m2 for space and water heating			10.9133	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0179	(272b)
Emissions per m2 for pumps and fans			0.2695	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.9133 * 1.00) + 2.0179 + 0.2695, rounded to 2 d.p.			13.2000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-10	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 10, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	87 B	**DER**	12.88	**TER**	15.00
Environmental	89 B	**% DER<TER**	14.14		
CO_2 Emissions (t/year)	1.23	**DFEE**	34.54	**TFEE**	41.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.64		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	115.2400 (1b)	x	2.6500 (2b)	=	305.3860	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.2400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.3860	(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) =	0.1310	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3810	(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) =	0.3238	(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	0.4129	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5664	0.5724	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
Main Type 3	31.1100	12.5700	18.5400	0.1700	3.1518	110.0000	2039.4000	(29a)
Corridor	18.6000	1.7200	16.8800	0.2257	3.8104	110.0000	1856.8000	(29a)
PIJ	17.6100		17.6100	0.1600	2.8176	9.0000	158.4900	(30)
Total net area of external elements Aum(A, m2)			67.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.5086			(33)
Party Wall 1			71.2900	0.0000	0.0000	20.0000	1425.8000	(32)
Party Floor 1			115.2400			40.0000	4609.6000	(32d)
Party Ceilings 1			97.6300			30.0000	2928.9000	(32b)
Internal Wall 1			209.7700			9.0000	1887.9300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 14906.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	129.3554	(35)
Thermal bridges (User defined value 0.150 * total exposed area)	10.0980	(36)
Total fabric heat loss	(33) + (36) = 38.6066	(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	58.9788	58.6453	58.3183	56.7826	56.4952	55.1577	55.1577	54.9100	55.6729	56.4952	57.0765	57.6842	(38)
Heat transfer coeff	97.5854	97.2518	96.9249	95.3891	95.1018	93.7642	93.7642	93.5165	94.2794	95.1018	95.6831	96.2907	(39)
Average = Sum(39)m / 12 =												95.3878	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8468	0.8439	0.8411	0.8277	0.8252	0.8136	0.8136	0.8115	0.8181	0.8252	0.8303	0.8356	(40)
HLP (average)												0.8277	(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	2.8429	(42)
Average daily hot water use (litres/day)	101.7185	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8904	107.8216	103.7529	99.6841	95.6154	91.5467	91.5467	95.6154	99.6841	103.7529	107.8216	111.8904	(44)
Energy conte	165.9302	145.1236	149.7545	130.5596	125.2751	108.1029	100.1732	114.9502	116.3231	135.5633	147.9780	160.6945	(45)
Energy content (annual)										Total = Sum(45)m =		1600.4281	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8895	21.7685	22.4632	19.5839	18.7913	16.2154	15.0260	17.2425	17.4485	20.3345	22.1967	24.1042	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740 (61)

Total heat required for water heating calculated for each month

	177.6041	155.6678	161.4285	141.8570	136.9491	119.4003	111.8472	126.6242	127.6205	147.2373	159.2754	172.3685 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

FGHRS	-45.4336	-38.2456	-36.1768	-26.7451	-18.9837	-7.7834	-7.2125	-8.2764	-8.3753	-26.5557	-35.8355	-45.2073 eq.(G2)

Output from w/h

	132.1705	117.4222	125.2517	115.1120	117.9653	111.6169	104.6347	118.3478	119.2452	120.6816	123.4398	127.1612 (64)

Total per year (kWh/year) = Sum(64)m = 1433.0489 (64)

Heat gains from water heating, kWh/month

	58.0903	50.8897	52.7119	46.2354	44.5725	38.7686	36.2261	41.1394	41.5018	47.9933	52.0270	56.3494 (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	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	(66)

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

	28.1807	25.0298	20.3556	15.4105	11.5195	9.7253	10.5085	13.6594	18.3336	23.2787	27.1696	28.9639 (67)

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

	278.8800	281.7739	274.4813	258.9564	239.3589	220.9401	208.6351	205.7412	213.0338	228.5587	248.1562	266.5751 (68)

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

	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144 (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)

	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154 (71)

Water heating gains (Table 5)

	78.0783	75.7286	70.8493	64.2159	59.9092	53.8452	48.6910	55.2949	57.6414	64.5071	72.2598	75.7385 (72)

Total internal gains

	453.7822	451.1756	434.3295	407.2260	379.4309	353.1538	336.4779	343.3388	357.6520	384.9878	416.2289	439.9207 (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	12.5700	10.6334	0.6300	0.7000	0.7700	40.8488	(74)

Solar gains	40.8488	78.0641	132.6499	213.0698	287.0246	307.2683	286.8742	227.5981	159.4882	92.9251	50.3922	34.0535 (83)
Total gains	494.6310	529.2397	566.9795	620.2959	666.4555	660.4222	623.3521	570.9369	517.1402	477.9129	466.6211	473.9742 (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	42.4327	42.5782	42.7219	43.4097	43.5408	44.1619	44.1619	44.2789	43.9206	43.5408	43.2763	43.0032	
alpha	3.8288	3.8385	3.8481	3.8940	3.9027	3.9441	3.9441	3.9519	3.9280	3.9027	3.8851	3.8669	
util living area	0.9927	0.9897	0.9816	0.9567	0.8911	0.7579	0.6113	0.6730	0.8771	0.9689	0.9888	0.9938	(86)
MIT	19.3526	19.4910	19.7696	20.1836	20.5767	20.8544	20.9540	20.9327	20.7124	20.2336	19.7366	19.3350	(87)
Th 2	20.2130	20.2154	20.2179	20.2294	20.2315	20.2415	20.2415	20.2434	20.2377	20.2315	20.2272	20.2226	(88)
util rest of house	0.9914	0.9878	0.9781	0.9475	0.8661	0.7012	0.5235	0.5879	0.8393	0.9606	0.9865	0.9928	(89)
MIT 2	17.9615	18.1650	18.5724	19.1782	19.7318	20.1005	20.2091	20.1924	19.9283	19.2565	18.5319	17.9421	(90)
Living area fraction									fLA = Living area / (4) =			0.2165	(91)
MIT	18.2627	18.4521	18.8316	19.3959	19.9147	20.2637	20.3703	20.3527	20.0980	19.4681	18.7927	18.2436	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1127	18.3021	18.6816	19.2459	19.7647	20.1137	20.2203	20.2027	19.9480	19.3181	18.6427	18.0936	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9811	0.9682	0.9321	0.8478	0.6906	0.5208	0.5829	0.8218	0.9471	0.9794	0.9882	(94)
Useful gains	487.8366	519.2281	548.9464	578.1795	565.0429	456.0953	324.6596	332.7726	424.9744	452.6375	456.9981	468.4025	(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	1347.9143	1303.3808	1180.7009	986.8869	766.9719	516.9865	339.4589	355.6134	551.3497	829.1056	1104.4416	1337.8295	(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	639.8978	526.9506	470.0253	294.2693	150.2352	0.0000	0.0000	0.0000	0.0000	280.0922	466.1593	646.8537	(98)
Space heating												3474.4835	(98)
Space heating per m2											(98) / (4) =	30.1500	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3873.4488	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.8978	526.9506	470.0253	294.2693	150.2352	0.0000	0.0000	0.0000	0.0000	280.0922	466.1593	646.8537	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	713.3755	587.4588	523.9970	328.0595	167.4863	0.0000	0.0000	0.0000	0.0000	312.2544	519.6871	721.1301	(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													
	132.1705	117.4222	125.2517	115.1120	117.9653	111.6169	104.6347	118.3478	119.2452	120.6816	123.4398	127.1612	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.2079	89.1764	89.0960	88.8946	88.4465	86.9000	86.9000	86.9000	86.9000	88.8381	89.0990	89.2277	(217)
Fuel for water heating, kWh/month													
	148.1601	131.6741	140.5806	129.4926	133.3747	128.4429	120.4082	136.1885	137.2212	135.8445	138.5424	142.5132	(219)
Water heating fuel used												1622.4429	(219)
Annual totals kWh/year													
Space heating fuel - main system												3873.4488	(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)												497.6793	(232)
Total delivered energy for all uses												6068.5710	(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	3873.4488	0.2160	836.6649	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1622.4429	0.2160	350.4477	(264)
Space and water heating			1187.1126	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	497.6793	0.5190	258.2956	(268)
Total CO2, kg/year			1484.3332	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.8800	(273)

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

DER		12.8800	ZC1
Total Floor Area	TFA	115.2400	
Assumed number of occupants	N	2.8429	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3404	ZC2
CO2 emissions from cooking, equation (L16)		1.6247	ZC3
Total CO2 emissions		28.8451	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		28.8451	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	115.2400 (1b)	x	2.6500 (2b)	=	305.3860	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.2400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.3860	(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) =	0.1310	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3810	(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) =		0.3238	(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	0.4129	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5664	0.5724	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
Main Type 3	31.1100	12.5700	18.5400	0.1800	3.3372			(29a)
Corridor	18.6000	1.7200	16.8800	0.1800	3.0384			(29a)
PIJ	17.6100		17.6100	0.1300	2.2893			(30)
Total net area of external elements Aum(A, m2)			67.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0497			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6143	(36)
Total fabric heat loss						(33) + (36) =	39.6640	(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	58.9788	58.6453	58.3183	56.7826	56.4952	55.1577	55.1577	54.9100	55.6729	56.4952	57.0765	57.6842	(38)
Heat transfer coeff	98.6428	98.3092	97.9823	96.4465	96.1592	94.8217	94.8217	94.5740	95.3369	96.1592	96.7405	97.3482	(39)
Average = Sum(39)m / 12 =												96.4452	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8560	0.8531	0.8502	0.8369	0.8344	0.8228	0.8228	0.8207	0.8273	0.8344	0.8395	0.8447	(40)
HLP (average)												0.8369	(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												2.8429	(42)
Average daily hot water use (litres/day)												101.7185	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8904	107.8216	103.7529	99.6841	95.6154	91.5467	91.5467	95.6154	99.6841	103.7529	107.8216	111.8904	(44)
Energy conte	165.9302	145.1236	149.7545	130.5596	125.2751	108.1029	100.1732	114.9502	116.3231	135.5633	147.9780	160.6945	(45)
Energy content (annual)										Total = Sum(45)m =		1600.4281	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8895	21.7685	22.4632	19.5839	18.7913	16.2154	15.0260	17.2425	17.4485	20.3345	22.1967	24.1042	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	49.1593	48.7246	45.1463	46.6512	48.7246	49.1593	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.8891	191.1510	200.7134	179.7189	173.9996	153.2492	146.8244	163.6748	165.4824	186.5222	197.2930	211.6534	(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													
	216.8891	191.1510	200.7134	179.7189	173.9996	153.2492	146.8244	163.6748	165.4824	186.5222	197.2930	211.6534	(64)
Total per year (kWh/year) = Sum(64)m =												2187.1714	(64)
Heat gains from water heating, kWh/month													
	67.9115	59.7604	62.5331	55.7009	53.8351	47.2308	44.9704	50.4021	50.9672	57.8145	61.5314	66.1706	(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	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.1807	25.0298	20.3556	15.4105	11.5195	9.7253	10.5085	13.6594	18.3336	23.2787	27.1696	28.9639	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	278.8800	281.7739	274.4813	258.9564	239.3589	220.9401	208.6351	205.7412	213.0338	228.5587	248.1562	266.5751	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	(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)													
	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	(71)
Water heating gains (Table 5)													
	91.2789	88.9292	84.0499	77.3624	72.3590	65.5983	60.4441	67.7447	70.7878	77.7077	85.4603	88.9390	(72)
Total internal gains													
	466.9828	464.3762	447.5301	420.3725	391.8807	364.9069	348.2310	355.7886	370.7985	398.1884	429.4294	453.1213	(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	12.5700	10.6334	0.6300	0.7000	0.7700	40.8488	(74)

Solar gains	40.8488	78.0641	132.6499	213.0698	287.0246	307.2683	286.8742	227.5981	159.4882	92.9251	50.3922	34.0535	(83)
Total gains	507.8316	542.4403	580.1800	633.4424	678.9053	672.1752	635.1052	583.3867	530.2867	491.1135	479.8216	487.1748	(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	81.1289	81.4041	81.6758	82.9763	83.2242	84.3982	84.3982	84.6193	83.9421	83.2242	82.7242	82.2078	
alpha	6.4086	6.4269	6.4451	6.5318	6.5483	6.6265	6.6265	6.6413	6.5961	6.5483	6.5149	6.4805	
util living area													
	0.9996	0.9993	0.9982	0.9915	0.9547	0.8205	0.6424	0.7155	0.9419	0.9951	0.9992	0.9997	(86)
MIT	20.0186	20.1034	20.2745	20.5342	20.7872	20.9521	20.9920	20.9847	20.8629	20.5579	20.2526	20.0090	(87)
Th 2	20.2051	20.2076	20.2100	20.2215	20.2236	20.2336	20.2336	20.2355	20.2297	20.2236	20.2193	20.2147	(88)
util rest of house													
	0.9995	0.9991	0.9975	0.9878	0.9341	0.7517	0.5381	0.6115	0.9065	0.9925	0.9989	0.9996	(89)
MIT 2	18.8666	18.9925	19.2446	19.6313	19.9887	20.1969	20.2301	20.2278	20.0983	19.6690	19.2199	18.8598	(90)
Living area fraction									fLA = Living area / (4) =			0.2165	(91)
MIT	19.1160	19.2330	19.4676	19.8268	20.1616	20.3604	20.3951	20.3917	20.2638	19.8614	19.4435	19.1086	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1160	19.2330	19.4676	19.8268	20.1616	20.3604	20.3951	20.3917	20.2638	19.8614	19.4435	19.1086	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9987	0.9965	0.9853	0.9321	0.7641	0.5608	0.6339	0.9085	0.9908	0.9984	0.9994	(94)
Useful gains	507.4527	541.7173	578.1581	624.1506	632.7940	513.6403	356.1899	369.8356	481.7515	486.5925	479.0654	486.9007	(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													
	1461.4903	1409.0651	1270.5928	1053.8537	813.6599	546.2079	359.8530	377.5108	587.6398	890.5706	1194.1160	1451.3263	(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													
	709.8039	582.8578	515.1714	309.3862	134.5642	0.0000	0.0000	0.0000	0.0000	300.5597	514.8364	717.5326	(98)
Space heating												3784.7123	(98)
Space heating per m2											(98) / (4) =	32.8420	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4052.1544	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	709.8039	582.8578	515.1714	309.3862	134.5642	0.0000	0.0000	0.0000	0.0000	300.5597	514.8364	717.5326	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	759.9614	624.0447	551.5754	331.2486	144.0730	0.0000	0.0000	0.0000	0.0000	321.7984	551.2167	768.2362	(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													
	216.8891	191.1510	200.7134	179.7189	173.9996	153.2492	146.8244	163.6748	165.4824	186.5222	197.2930	211.6534	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8149	87.6765	87.3207	86.4066	84.4129	80.3000	80.3000	80.3000	80.3000	86.2459	87.3560	87.8822	(217)
Fuel for water heating, kWh/month													
	246.9843	218.0184	229.8579	207.9922	206.1292	190.8458	182.8448	203.8291	206.0802	216.2679	225.8496	240.8378	(219)
Water heating fuel used												2575.5370	(219)
Annual totals kWh/year													
Space heating fuel - main system												4052.1544	(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)												497.6793	(232)
Total delivered energy for all uses												7200.3708	(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	4052.1544	0.2160	875.2654	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2575.5370	0.2160	556.3160	(264)
Space and water heating			1431.5814	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	497.6793	0.5190	258.2956	(268)
Total CO2, kg/m2/year			1728.8019	(272)
Emissions per m2 for space and water heating			12.4226	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2414	(272b)
Emissions per m2 for pumps and fans			0.3378	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.4226 * 1.00) + 2.2414 + 0.3378, rounded to 2 d.p.			15.0000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-11	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 11, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.77	**TER**	17.58
Environmental	88 B	**% DER<TER**	15.98		
CO_2 Emissions (t/year)	1.18	**DFEE**	39.87	**TFEE**	51.01
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.83		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	95.6000 (1b)	x	2.6500 (2b)	=	253.3400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.3400	(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) =	0.1579	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4079	(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) =	0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3900	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			9.2600	1.3258	12.2765			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Main Type 3	60.2900	9.2600	51.0300	0.1700	8.6751	110.0000	5613.3000	(29a)
Corridor	5.4600	1.7200	3.7400	0.2257	0.8442	110.0000	411.4000	(29a)
PIJ	34.1300	2.5100	31.6200	0.1600	5.0592	9.0000	284.5800	(30)
Total net area of external elements Aum(A, m2)			99.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.2467			(33)
Party Wall 1			61.2900	0.0000	0.0000	20.0000	1225.8000	(32)
Party Floor 1			95.6000			40.0000	3824.0000	(32d)
Party Ceilings 1			61.4800			30.0000	1844.4000	(32b)
Internal Wall 1			168.4900			9.0000	1516.4100	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14719.8900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							153.9737	(35)
Thermal bridges (User defined value 0.150 * total exposed area)							14.9820	(36)
Total fabric heat loss					(33) + (36) =		47.2287	(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	49.9694	49.6522	49.3413	47.8810	47.6078	46.3359	46.3359	46.1004	46.8258	47.6078	48.1605	48.7384	(38)
Heat transfer coeff	97.1981	96.8810	96.5700	95.1097	94.8365	93.5646	93.5646	93.3291	94.0545	94.8365	95.3892	95.9671	(39)
Average = Sum(39)m / 12 =												95.1084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0167	1.0134	1.0101	0.9949	0.9920	0.9787	0.9787	0.9762	0.9838	0.9920	0.9978	1.0038	(40)
HLP (average)												0.9949	(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	2.6949	(42)
Average daily hot water use (litres/day)	98.2036	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0240	104.0959	100.1677	96.2396	92.3114	88.3833	88.3833	92.3114	96.2396	100.1677	104.0959	108.0240	(44)
Energy conte	160.1965	140.1089	144.5798	126.0482	120.9462	104.3674	96.7117	110.9781	112.3036	130.8790	142.8646	155.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1545.1257	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.0295	21.0163	21.6870	18.9072	18.1419	15.6551	14.5068	16.6467	16.8455	19.6318	21.4297	23.2713	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)
Total heat required for water heating calculated for each month													
	171.8705	150.6531	156.2538	137.3456	132.6202	115.6648	108.3857	122.6521	123.6010	142.5529	154.1620	166.8157	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-45.0321	-37.4179	-34.5972	-24.8201	-16.4505	-7.5145	-6.9632	-7.9904	-8.0859	-25.5834	-35.3438	-44.9098	eq.(G2)
Output from w/h													
	126.8384	113.2352	121.6565	112.5254	116.1697	108.1503	101.4225	114.6617	115.5151	116.9696	118.8182	121.9059	(64)
									Total per year (kWh/year) = Sum(64)m =			1387.8685	(64)
Heat gains from water heating, kWh/month													
	56.1838	49.2223	50.9913	44.7354	43.1331	37.5265	35.0751	39.8187	40.1653	46.4358	50.3268	54.5031	(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	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2699	21.5563	17.5307	13.2719	9.9209	8.3756	9.0502	11.7638	15.7893	20.0481	23.3991	24.9444	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.0121	251.5960	245.0845	231.2223	213.7237	197.2775	186.2904	183.7065	190.2180	204.0802	221.5788	238.0250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	(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)													
	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	(71)
Water heating gains (Table 5)													
	75.5159	73.2474	68.5367	62.1325	57.9746	52.1201	47.1440	53.5198	55.7851	62.4136	69.8984	73.2569	(72)
Total internal gains													
	415.2212	412.8230	397.5753	373.0500	348.0426	324.1966	308.9080	315.4134	328.2157	352.9653	381.2997	402.6496	(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	9.2600	10.6334	0.6300	0.7000	0.7700	30.0922	(74)
East	2.5100	26.6072	0.7400	0.7000	1.0000	31.1348	(82)

Solar gains	61.2270	120.4533	206.4820	323.6419	422.9082	446.0230	419.1509	341.3543	246.6021	144.4837	76.3093	50.4570	(83)
Total gains	476.4482	533.2763	604.0573	696.6918	770.9508	770.2196	728.0589	656.7677	574.8178	497.4490	457.6090	453.1067	(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	42.0672	42.2050	42.3409	42.9910	43.1148	43.7009	43.7009	43.8112	43.4733	43.1148	42.8650	42.6069	
alpha	3.8045	3.8137	3.8227	3.8661	3.8743	3.9134	3.9134	3.9207	3.8982	3.8743	3.8577	3.8405	
util living area													
	0.9933	0.9890	0.9767	0.9379	0.8446	0.6864	0.5374	0.6049	0.8411	0.9638	0.9891	0.9945	(86)
MIT	19.3191	19.4896	19.8135	20.2686	20.6603	20.8964	20.9698	20.9527	20.7559	20.2541	19.7169	19.2961	(87)
Th 2	20.0694	20.0722	20.0749	20.0876	20.0900	20.1011	20.1011	20.1032	20.0968	20.0900	20.0852	20.0801	(88)
util rest of house													
	0.9919	0.9866	0.9714	0.9230	0.8072	0.6152	0.4388	0.5052	0.7882	0.9524	0.9864	0.9933	(89)
MIT 2	17.7997	18.0498	18.5218	19.1810	19.7163	20.0126	20.0836	20.0733	19.8572	19.1713	18.3910	17.7730	(90)
Living area fraction									fLA = Living area / (4) =			0.2610	(91)
MIT	18.1962	18.4256	18.8589	19.4648	19.9627	20.2433	20.3149	20.3028	20.0917	19.4539	18.7370	18.1705	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0462	18.2756	18.7089	19.3148	19.8127	20.0933	20.1649	20.1528	19.9417	19.3039	18.5870	18.0205	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9872	0.9798	0.9606	0.9071	0.7940	0.6145	0.4462	0.5111	0.7775	0.9390	0.9796	0.9893	(94)
Useful gains	470.3412	522.5061	580.2599	632.0018	612.1591	473.2839	324.8430	335.6894	446.9200	467.0925	448.2955	448.2570	(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													
	1336.1078	1295.8372	1179.0179	990.5522	769.3790	513.9772	333.5501	350.2458	549.4420	825.4472	1095.7400	1326.3114	(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													
	644.1304	519.6785	445.4760	258.1563	116.9716	0.0000	0.0000	0.0000	0.0000	266.6158	466.1600	653.2725	(98)
Space heating												3370.4611	(98)
Space heating per m2											(98) / (4) =	35.2559	(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)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3757.4817	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	644.1304	519.6785	445.4760	258.1563	116.9716	0.0000	0.0000	0.0000	0.0000	266.6158	466.1600	653.2725	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	718.0941	579.3517	496.6287	287.7996	130.4031	0.0000	0.0000	0.0000	0.0000	297.2306	519.6879	728.2859	(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													
	126.8384	113.2352	121.6565	112.5254	116.1697	108.1503	101.4225	114.6617	115.5151	116.9696	118.8182	121.9059	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.2270	89.1859	89.0843	88.8311	88.2826	86.9000	86.9000	86.9000	86.9000	88.8272	89.1168	89.2478	(217)
Fuel for water heating, kWh/month													
	142.1525	126.9654	136.5634	126.6734	131.5884	124.4538	116.7117	131.9467	132.9288	131.6821	133.3287	136.5927	(219)
Water heating fuel used												1571.5875	(219)
Annual totals kWh/year													
Space heating fuel - main system												3757.4817	(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)												428.6132	(232)
Total delivered energy for all uses												5832.6824	(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	3757.4817	0.2160	811.6160	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1571.5875	0.2160	339.4629	(264)
Space and water heating			1151.0789	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	428.6132	0.5190	222.4502	(268)
Total CO2, kg/year			1412.4542	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.7700	(273)

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

DER		14.7700	ZC1
Total Floor Area	TFA	95.6000	
Assumed number of occupants	N	2.6949	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4351	ZC2
CO2 emissions from cooking, equation (L16)		1.9213	ZC3
Total CO2 emissions		32.1264	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		32.1264	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	95.6000 (1b)	x	2.6500 (2b)	=	253.3400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.3400	(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) =	0.1184	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3684	(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) =	0.3132	(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	0.3993	0.3914	0.3836	0.3445	0.3366	0.2975	0.2975	0.2897	0.3132	0.3366	0.3523	0.3680	(22b)
Effective ac	0.5797	0.5766	0.5736	0.5593	0.5567	0.5443	0.5443	0.5420	0.5490	0.5567	0.5621	0.5677	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			9.2600	1.3258	12.2765			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Main Type 3	60.2900	9.2600	51.0300	0.1800	9.1854			(29a)
Corridor	5.4600	1.7200	3.7400	0.1800	0.6732			(29a)
PIJ	34.1300	2.5100	31.6200	0.1300	4.1106			(30)
Total net area of external elements Aum(A, m2)			99.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.9610			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3140	(36)
Total fabric heat loss (33) + (36) =	52.2750	(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	48.4650	48.2062	47.9526	46.7612	46.5383	45.5007	45.5007	45.3085	45.9004	46.5383	46.9892	47.4607	(38)
Heat transfer coeff	100.7400	100.4813	100.2276	99.0363	98.8134	97.7757	97.7757	97.5836	98.1754	98.8134	99.2643	99.7357	(39)
Average = Sum(39)m / 12 =												99.0352	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0538	1.0511	1.0484	1.0359	1.0336	1.0228	1.0228	1.0207	1.0269	1.0336	1.0383	1.0433	(40)
HLP (average)												1.0359	(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	2.6949 (42)
Average daily hot water use (litres/day)	98.2036 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0240	104.0959	100.1677	96.2396	92.3114	88.3833	88.3833	92.3114	96.2396	100.1677	104.0959	108.0240	(44)
Energy conte	160.1965	140.1089	144.5798	126.0482	120.9462	104.3674	96.7117	110.9781	112.3036	130.8790	142.8646	155.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1545.1257	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0295	21.0163	21.6870	18.9072	18.1419	15.6551	14.5068	16.6467	16.8455	19.6318	21.4297	23.2713	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4606	47.0409	43.5863	45.0391	47.0409	47.4606	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.1554	186.1363	195.5387	173.5088	167.9871	147.9537	141.7509	158.0190	159.7642	181.8379	192.1797	206.1006	(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													
	211.1554	186.1363	195.5387	173.5088	167.9871	147.9537	141.7509	158.0190	159.7642	181.8379	192.1797	206.1006	(64)
								Total per year (kWh/year) = Sum(64)m =				2121.9322	(64)
Heat gains from water heating, kWh/month													
	66.0051	58.0930	60.8125	53.7762	51.9748	45.5987	43.4164	48.6604	49.2061	56.2570	59.8313	64.3244	(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	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2699	21.5563	17.5307	13.2719	9.9209	8.3756	9.0502	11.7638	15.7893	20.0481	23.3991	24.9444	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.0121	251.5960	245.0845	231.2223	213.7237	197.2775	186.2904	183.7065	190.2180	204.0802	221.5788	238.0250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	(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)													
	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	(71)
Water heating gains (Table 5)													
	88.7165	86.4480	81.7372	74.6891	69.8587	63.3316	58.3554	65.4038	68.3418	75.6142	83.0990	86.4575	(72)
Total internal gains													
	428.4217	426.0236	410.7758	385.6066	359.9266	335.4080	320.1194	327.2974	340.7724	366.1659	394.5002	415.8502	(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	9.2600	10.6334	0.6300	0.7000	0.7700	30.0922	(74)
East	2.5100	26.6072	0.6300	0.7000	1.0000	26.5066	(82)

Solar gains	56.5989	111.0965	190.3146	298.8653	391.4743	413.3699	388.2591	315.5357	227.4099	133.1822	70.4843	46.6857	(83)
Total gains	485.0206	537.1202	601.0905	684.4719	751.4009	748.7779	708.3784	642.8331	568.1823	499.3481	464.9845	462.5359	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.9012	66.0709	66.2381	67.0349	67.1861	67.8991	67.8991	68.0329	67.6227	67.1861	66.8809	66.5648	
alpha	5.3934	5.4047	5.4159	5.4690	5.4791	5.5266	5.5266	5.5355	5.5082	5.4791	5.4587	5.4377	
util living area													
	0.9991	0.9983	0.9951	0.9794	0.9169	0.7619	0.5916	0.6664	0.9102	0.9901	0.9982	0.9993	(86)
MIT	19.8023	19.9180	20.1440	20.4703	20.7692	20.9444	20.9888	20.9794	20.8390	20.4648	20.0819	19.7844	(87)
Th 2	20.0388	20.0410	20.0432	20.0535	20.0554	20.0644	20.0644	20.0661	20.0609	20.0554	20.0515	20.0474	(88)
util rest of house													
	0.9988	0.9977	0.9932	0.9709	0.8826	0.6780	0.4739	0.5467	0.8586	0.9847	0.9975	0.9991	(89)
MIT 2	18.4262	18.5970	18.9285	19.4069	19.8166	20.0252	20.0600	20.0568	19.9176	19.4048	18.8445	18.4063	(90)
Living area fraction									fLA = Living area / (4) =			0.2610	(91)
MIT	18.7854	18.9417	19.2457	19.6845	20.0652	20.2651	20.3024	20.2975	20.1581	19.6814	19.1675	18.7660	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7854	18.9417	19.2457	19.6845	20.0652	20.2651	20.3024	20.2975	20.1581	19.6814	19.1675	18.7660	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9966	0.9910	0.9666	0.8830	0.6974	0.5048	0.5780	0.8650	0.9817	0.9965	0.9986	(94)
Useful gains	484.1683	535.3174	595.6827	661.6190	663.4654	522.2320	357.6146	371.5504	491.4810	490.2196	463.3565	461.9105	(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													
	1459.2571	1410.9310	1277.4725	1068.0518	826.5926	553.9071	362.0014	380.3361	594.7519	897.3649	1197.8669	1452.7453	(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													
	725.4661	588.4124	507.2516	292.6316	121.3667	0.0000	0.0000	0.0000	0.0000	302.9161	528.8474	737.1811	(98)
Space heating												3804.0730	(98)
Space heating per m2											(98) / (4) =	39.7916	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4072.8833	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	725.4661	588.4124	507.2516	292.6316	121.3667	0.0000	0.0000	0.0000	0.0000	302.9161	528.8474	737.1811	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	776.7303	629.9919	543.0959	313.3100	129.9429	0.0000	0.0000	0.0000	0.0000	324.3213	566.2178	789.2731	(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													
	211.1554	186.1363	195.5387	173.5088	167.9871	147.9537	141.7509	158.0190	159.7642	181.8379	192.1797	206.1006	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9073	87.7477	87.3434	86.3570	84.2481	80.3000	80.3000	80.3000	80.3000	86.3270	87.4677	87.9821	(217)
Fuel for water heating, kWh/month													
	240.2023	212.1267	223.8735	200.9204	199.3958	184.2511	176.5266	196.7858	198.9591	210.6385	219.7151	234.2529	(219)
Water heating fuel used												2497.6479	(219)
Annual totals kWh/year													
Space heating fuel - main system												4072.8833	(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)												428.6132	(232)
Total delivered energy for all uses												7074.1444	(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	4072.8833	0.2160	879.7428	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2497.6479	0.2160	539.4920	(264)
Space and water heating			1419.2347	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	428.6132	0.5190	222.4502	(268)
Total CO2, kg/m2/year			1680.6100	(272)
Emissions per m2 for space and water heating			14.8456	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3269	(272b)
Emissions per m2 for pumps and fans			0.4072	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8456 * 1.00) + 2.3269 + 0.4072, rounded to 2 d.p.			17.5800	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-12	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Mid
Property	Plot 12, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	15.06	**TER**	17.74
Environmental	88 B	**% DER<TER**	15.12		
CO_2 Emissions (t/year)	1.21	**DFEE**	40.48	**TFEE**	51.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.16		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	96.2900 (1b)	x	2.6500 (2b)	=	255.1685	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.1685	(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) =	0.1568	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4068	(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) =	0.3457	(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	0.4408	0.4322	0.4235	0.3803	0.3717	0.3285	0.3285	0.3198	0.3457	0.3717	0.3890	0.4063	(22b)
Effective ac	0.5972	0.5934	0.5897	0.5723	0.5691	0.5539	0.5539	0.5511	0.5598	0.5691	0.5756	0.5825	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			8.8500	1.3258	11.7330			(27)
Velux (Uw = 1.40)			0.6300	1.3258	0.8352			(27a)
Main Type 3	65.0900	8.8500	56.2400	0.1700	9.5608	110.0000	6186.4000	(29a)
Corridor	18.0700	1.7200	16.3500	0.2257	3.6907	110.0000	1798.5000	(29a)
PIJ	36.8400	0.6300	36.2100	0.1600	5.7936	9.0000	325.8900	(30)
Total net area of external elements Aum(A, m2)			120.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6773			(33)
Party Wall 1			61.2900	0.0000	0.0000	20.0000	1225.8000	(32)
Party Floor 1			96.2900			40.0000	3851.6000	(32d)
Party Ceilings 1			59.4500			30.0000	1783.5000	(32b)
Internal Wall 1			168.4900			9.0000	1516.4100	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16688.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		173.3108 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		18.0000 (36)
Total fabric heat loss	(33) + (36) =	51.6773 (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	50.2845	49.9668	49.6554	48.1927	47.9190	46.6450	46.6450	46.4091	47.1358	47.9190	48.4726	49.0514	(38)
Heat transfer coeff	101.9618	101.6441	101.3327	99.8700	99.5963	98.3224	98.3224	98.0865	98.8131	99.5963	100.1500	100.7288	(39)
Average = Sum(39)m / 12 =												99.8687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0589	1.0556	1.0524	1.0372	1.0343	1.0211	1.0211	1.0187	1.0262	1.0343	1.0401	1.0461	(40)
HLP (average)												1.0372	(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	2.7024 (42)
Average daily hot water use (litres/day)	98.3826 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.2208	104.2855	100.3502	96.4149	92.4796	88.5443	88.5443	92.4796	96.4149	100.3502	104.2855	108.2208	(44)
Energy conte	160.4884	140.3642	144.8432	126.2779	121.1666	104.5576	96.8880	111.1803	112.5082	131.1175	143.1250	155.4244	(45)
Energy content (annual)										Total = Sum(45)m =		1547.9412	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.0733	21.0546	21.7265	18.9417	18.1750	15.6836	14.5332	16.6771	16.8762	19.6676	21.4687	23.3137	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)
Total heat required for water heating calculated for each month													
	172.1624	150.9084	156.5172	137.5753	132.8406	115.8550	108.5619	122.8543	123.8056	142.7914	154.4224	167.0984	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-45.9182	-37.6958	-34.9960	-25.7971	-18.2815	-7.5281	-6.9759	-8.0050	-8.1006	-25.2570	-35.6238	-45.9369	eq.(G2)
Output from w/h													
	126.2441	113.2126	121.5213	111.7782	114.5591	108.3268	101.5860	114.8493	115.7050	117.5344	118.7985	121.1615	(64)
									Total per year (kWh/year) = Sum(64)m =			1385.2769	(64)
Heat gains from water heating, kWh/month													
	56.2809	49.3071	51.0789	44.8117	43.2064	37.5897	35.1337	39.8860	40.2333	46.5150	50.4134	54.5971	(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	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.7666	22.8857	18.6119	14.0904	10.5327	8.8922	9.6083	12.4892	16.7630	21.2845	24.8422	26.4827	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	250.1867	252.7829	246.2407	232.3130	214.7319	198.2081	187.1692	184.5731	191.1153	205.0429	222.6241	239.1478	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	(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)													
	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	(71)
Water heating gains (Table 5)													
	75.6463	73.3737	68.6544	62.2385	58.0731	52.2080	47.2228	53.6102	55.8796	62.5202	70.0186	73.3832	(72)
Total internal gains													
	418.1361	415.5787	400.0433	375.1783	349.8741	325.8446	310.5367	317.2088	330.2943	355.3840	384.0212	405.5502	(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	3.3200	19.6403	0.6300	0.7000	0.7700	19.9277	(76)
South	5.5300	46.7521	0.6300	0.7000	0.7700	79.0129	(78)
East	0.6300	26.6072	0.7400	0.7000	1.0000	7.8147	(82)

Solar gains	106.7553	184.1846	256.3341	321.7669	361.9613	359.4303	346.5372	316.9325	279.2634	204.9121	128.3404	91.0299	(83)
Total gains	524.8913	599.7632	656.3774	696.9452	711.8354	685.2750	657.0739	634.1414	609.5577	560.2961	512.3616	496.5801	(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	45.4639	45.6060	45.7462	46.4162	46.5437	47.1468	47.1468	47.2602	46.9126	46.5437	46.2864	46.0205	
alpha	4.0309	4.0404	4.0497	4.0944	4.1029	4.1431	4.1431	4.1507	4.1275	4.1029	4.0858	4.0680	
util living area													
	0.9940	0.9890	0.9785	0.9527	0.8937	0.7698	0.6133	0.6511	0.8473	0.9614	0.9893	0.9952	(86)
MIT	19.4452	19.6254	19.9095	20.2794	20.6158	20.8648	20.9607	20.9490	20.7806	20.3416	19.8293	19.4179	(87)
Th 2	20.0345	20.0373	20.0399	20.0525	20.0548	20.0658	20.0658	20.0678	20.0616	20.0548	20.0501	20.0451	(88)
util rest of house													
	0.9925	0.9863	0.9730	0.9396	0.8613	0.6976	0.5016	0.5426	0.7910	0.9482	0.9863	0.9940	(89)
MIT 2	17.9457	18.2098	18.6236	19.1628	19.6300	19.9502	20.0440	20.0373	19.8537	19.2588	18.5166	17.9128	(90)
Living area fraction									fLA = Living area / (4) =			0.2214	(91)
MIT	18.2777	18.5232	18.9083	19.4100	19.8482	20.1527	20.2470	20.2392	20.0589	19.4985	18.8073	18.2460	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1277	18.3732	18.7583	19.2600	19.6982	20.0027	20.0970	20.0892	19.9089	19.3485	18.6573	18.0960	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9882	0.9797	0.9629	0.9253	0.8465	0.6921	0.5056	0.5454	0.7801	0.9348	0.9797	0.9904	(94)
Useful gains	518.7097	587.5791	632.0265	644.8686	602.5376	474.2603	332.2137	345.8311	475.4884	523.7814	501.9729	491.8251	(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													
	1409.9018	1369.4722	1242.1698	1034.6538	796.5960	531.2098	343.8307	361.8608	573.9979	871.3199	1157.4613	1399.7280	(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													
	663.0469	525.4321	453.9466	280.6453	144.3795	0.0000	0.0000	0.0000	0.0000	258.5686	471.9517	675.4798	(98)
Space heating												3473.4506	(98)
Space heating per m2											(98) / (4) =	36.0728	(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)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3872.2972	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	663.0469	525.4321	453.9466	280.6453	144.3795	0.0000	0.0000	0.0000	0.0000	258.5686	471.9517	675.4798	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	739.1827	585.7660	506.0720	312.8710	160.9582	0.0000	0.0000	0.0000	0.0000	288.2593	526.1446	753.0433	(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													
	126.2441	113.2126	121.5213	111.7782	114.5591	108.3268	101.5860	114.8493	115.7050	117.5344	118.7985	121.1615	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.2401	89.1906	89.0938	88.8842	88.4393	86.9000	86.9000	86.9000	86.9000	88.8058	89.1225	89.2626	(217)
Fuel for water heating, kWh/month													
	141.4657	126.9334	136.3970	125.7571	129.5342	124.6569	116.8999	132.1627	133.1473	132.3500	133.2980	135.7361	(219)
Water heating fuel used												1568.3381	(219)
Annual totals kWh/year													
Space heating fuel - main system												3872.2972	(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)												455.0461	(232)
Total delivered energy for all uses												5970.6814	(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	3872.2972	0.2160	836.4162	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1568.3381	0.2160	338.7610	(264)
Space and water heating			1175.1772	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	455.0461	0.5190	236.1689	(268)
Total CO2, kg/year			1450.2712	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.0600	(273)

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

DER		15.0600	ZC1
Total Floor Area	TFA	96.2900	
Assumed number of occupants	N	2.7024	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3968	ZC2
CO2 emissions from cooking, equation (L16)		1.9094	ZC3
Total CO2 emissions		32.3662	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		32.3662	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	96.2900 (1b)	x	2.6500 (2b)	=	255.1685	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.1685	(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) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3676	(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) =	0.3124	(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	0.3984	0.3905	0.3827	0.3437	0.3359	0.2968	0.2968	0.2890	0.3124	0.3359	0.3515	0.3671	(22b)
Effective ac	0.5793	0.5763	0.5732	0.5591	0.5564	0.5440	0.5440	0.5418	0.5488	0.5564	0.5618	0.5674	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			8.8500	1.3258	11.7330			(27)
TER Room Window (Uw = 1.70)			0.6300	1.5918	1.0028			(27a)
Main Type 3	65.0900	8.8500	56.2400	0.1800	10.1232			(29a)
Corridor	18.0700	1.7200	16.3500	0.1800	2.9430			(29a)
PIJ	36.8400	0.6300	36.2100	0.1300	4.7073			(30)
Total net area of external elements Aum(A, m2)			120.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.2293			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							24.9980	(36)
Total fabric heat loss					(33) + (36) =		57.2273	(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	48.7839	48.5245	48.2702	47.0757	46.8523	45.8120	45.8120	45.6193	46.2127	46.8523	47.3043	47.7770	(38)
Heat transfer coeff	106.0112	105.7517	105.4974	104.3030	104.0795	103.0392	103.0392	102.8466	103.4399	104.0795	104.5316	105.0042	(39)
Average = Sum(39)m / 12 =												104.3019	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1010	1.0983	1.0956	1.0832	1.0809	1.0701	1.0701	1.0681	1.0743	1.0809	1.0856	1.0905	(40)
HLP (average)												1.0832	(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												2.7024	(42)
Average daily hot water use (litres/day)												98.3826	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.2208	104.2855	100.3502	96.4149	92.4796	88.5443	88.5443	92.4796	96.4149	100.3502	104.2855	108.2208	(44)
Energy conte	160.4884	140.3642	144.8432	126.2779	121.1666	104.5576	96.8880	111.1803	112.5082	131.1175	143.1250	155.4244	(45)
Energy content (annual)										Total = Sum(45)m =		1547.9412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0733	21.0546	21.7265	18.9417	18.1750	15.6836	14.5332	16.6771	16.8762	19.6676	21.4687	23.3137	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.5471	47.1266	43.6657	45.1212	47.1266	47.5471	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.4473	186.3916	195.8022	173.8249	168.2932	148.2233	142.0092	158.3070	160.0553	182.0764	192.4400	206.3833	(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													
	211.4473	186.3916	195.8022	173.8249	168.2932	148.2233	142.0092	158.3070	160.0553	182.0764	192.4400	206.3833	(64)
								Total per year (kWh/year) = Sum(64)m =				2125.2536	(64)
Heat gains from water heating, kWh/month													
	66.1021	58.1779	60.9001	53.8742	52.0695	45.6818	43.4956	48.7491	49.2957	56.3363	59.9178	64.4184	(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	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.7666	22.8857	18.6119	14.0904	10.5327	8.8922	9.6083	12.4892	16.7630	21.2845	24.8422	26.4827	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	250.1867	252.7829	246.2407	232.3130	214.7319	198.2081	187.1692	184.5731	191.1153	205.0429	222.6241	239.1478	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	(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)													
	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	(71)
Water heating gains (Table 5)													
	88.8469	86.5743	81.8550	74.8252	69.9860	63.4470	58.4618	65.5230	68.4663	75.7208	83.2192	86.5838	(72)
Total internal gains													
	431.3366	428.7792	413.2439	387.7650	361.7870	337.0836	321.7757	329.1217	342.8810	368.5846	397.2218	418.7507	(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	3.3200	19.6403	0.6300	0.7000	0.7700	19.9277	(76)
South	5.5300	46.7521	0.6300	0.7000	0.7700	79.0129	(78)
East	0.6300	26.6072	0.6300	0.7000	1.0000	6.6531	(82)

Solar gains	105.5936	181.8361	252.2761	315.5480	354.0715	351.2345	338.7835	310.4522	274.4462	202.0755	126.8783	90.0833	(83)
Total gains	536.9303	610.6153	665.5200	703.3131	715.8585	688.3182	660.5592	639.5738	617.3272	570.6601	524.1001	508.8340	(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	63.0764	63.2312	63.3836	64.1094	64.2471	64.8957	64.8957	65.0173	64.6443	64.2471	63.9692	63.6813	
alpha	5.2051	5.2154	5.2256	5.2740	5.2831	5.3264	5.3264	5.3345	5.3096	5.2831	5.2646	5.2454	
util living area													
	0.9986	0.9969	0.9927	0.9792	0.9377	0.8234	0.6544	0.6945	0.8958	0.9836	0.9970	0.9990	(86)
MIT	19.7854	19.9230	20.1439	20.4339	20.7070	20.9082	20.9791	20.9713	20.8410	20.4853	20.0817	19.7618	(87)
Th 2	20.0001	20.0023	20.0044	20.0146	20.0165	20.0253	20.0253	20.0270	20.0219	20.0165	20.0126	20.0086	(88)
util rest of house													
	0.9981	0.9959	0.9899	0.9705	0.9090	0.7433	0.5253	0.5691	0.8382	0.9752	0.9958	0.9986	(89)
MIT 2	18.3735	18.5760	18.8994	19.3252	19.7056	19.9567	20.0167	20.0138	19.8842	19.4037	18.8159	18.3451	(90)
Living area fraction										fLA = Living area / (4) =		0.2214	(91)
MIT	18.6861	18.8742	19.1749	19.5707	19.9273	20.1674	20.2298	20.2258	20.0960	19.6432	19.0962	18.6588	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6861	18.8742	19.1749	19.5707	19.9273	20.1674	20.2298	20.2258	20.0960	19.6432	19.0962	18.6588	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9941	0.9867	0.9653	0.9058	0.7565	0.5540	0.5966	0.8435	0.9707	0.9941	0.9978	(94)
Useful gains	535.4088	607.0333	656.6830	678.9417	648.3994	520.7443	365.9495	381.5848	520.7019	553.9642	520.9986	507.7390	(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													
	1525.0863	1477.8007	1337.1742	1112.9834	856.2953	573.6558	374.0119	393.4751	620.2283	941.2073	1253.9801	1518.2333	(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													
	736.3200	585.1557	506.2855	312.5100	154.6746	0.0000	0.0000	0.0000	0.0000	288.1089	527.7467	751.8078	(98)
Space heating												3862.6091	(98)
Space heating per m2											(98) / (4) =	40.1143	(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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4135.5557	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	736.3200	585.1557	506.2855	312.5100	154.6746	0.0000	0.0000	0.0000	0.0000	288.1089	527.7467	751.8078	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	788.3512	626.5050	542.0615	334.5931	165.6045	0.0000	0.0000	0.0000	0.0000	308.4677	565.0393	804.9334	(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													
	211.4473	186.3916	195.8022	173.8249	168.2932	148.2233	142.0092	158.3070	160.0553	182.0764	192.4400	206.3833	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9325	87.7341	87.3364	86.5109	84.8395	80.3000	80.3000	80.3000	80.3000	86.2014	87.4605	88.0156	(217)
Fuel for water heating, kWh/month													
	240.4654	212.4505	224.1930	200.9285	198.3665	184.5869	176.8483	197.1444	199.3217	211.2220	220.0307	234.4851	(219)
Water heating fuel used												2500.0429	(219)
Annual totals kWh/year													
Space heating fuel - main system												4135.5557	(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)												455.0461	(232)
Total delivered energy for all uses												7165.6448	(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	4135.5557	0.2160	893.2800	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2500.0429	0.2160	540.0093	(264)
Space and water heating			1433.2893	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	455.0461	0.5190	236.1689	(268)
Total CO2, kg/m2/year			1708.3833	(272)
Emissions per m2 for space and water heating			14.8851	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4527	(272b)
Emissions per m2 for pumps and fans			0.4042	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8851 * 1.00) + 2.4527 + 0.4042, rounded to 2 d.p.			17.7400	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-13	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Top
Property	Plot 13, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	15.53	**TER**	18.10
Environmental	87 B	**% DER<TER**	14.19		
CO_2 Emissions (t/year)	1.42	**DFEE**	47.56	**TFEE**	56.82
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.30		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	105.3600 (1b)	x	2.5000 (2b)	=	263.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.4000	(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) =	0.1519	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4019	(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) =	0.3416	(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	0.4355	0.4270	0.4184	0.3757	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014	(22b)
Effective ac	0.5948	0.5912	0.5875	0.5706	0.5674	0.5527	0.5527	0.5499	0.5583	0.5674	0.5738	0.5805	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Main Type 3	60.9100	10.2600	50.6500	0.1300	6.5845	9.0000	455.8500	(29a)
Corridor	15.9400	1.7200	14.2200	0.2257	3.2099	110.0000	1564.2000	(29a)
Fl	41.5500	2.5100	39.0400	0.1300	5.0752	9.0000	351.3600	(30)
PIR	92.5200		92.5200	0.1300	12.0276	9.0000	832.6800	(30)
Total net area of external elements Aum(A, m2)			210.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8912			(33)
Party Wall 1			20.1200	0.0000	0.0000	20.0000	402.4000	(32)
Party Floor 1			105.3600			40.0000	4214.4000	(32d)
Party Ceilings 1			59.4500			30.0000	1783.5000	(32b)
Internal Wall 1			195.9800			9.0000	1763.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11368.2100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		107.8987 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		31.6380 (36)
Total fabric heat loss	(33) + (36) =	77.5292 (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	51.7044	51.3843	51.0706	49.5968	49.3211	48.0375	48.0375	47.7998	48.5319	49.3211	49.8789	50.4621	(38)
Heat transfer coeff	129.2336	128.9135	128.5997	127.1260	126.8503	125.5667	125.5667	125.3290	126.0611	126.8503	127.4081	127.9912	(39)
Average = Sum(39)m / 12 =												127.1247	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2266	1.2236	1.2206	1.2066	1.2040	1.1918	1.1918	1.1895	1.1965	1.2040	1.2093	1.2148	(40)
HLP (average)												1.2066	(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	2.7839 (42)
Average daily hot water use (litres/day)	100.3180 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3498	106.3370	102.3243	98.3116	94.2989	90.2862	90.2862	94.2989	98.3116	102.3243	106.3370	110.3498	(44)
Energy conte	163.6455	143.1254	147.6926	128.7620	123.5502	106.6144	98.7939	113.3675	114.7214	133.6968	145.9405	158.4819	(45)
Energy content (annual)										Total = Sum(45)m =		1578.3921	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
               24.5468    21.4688    22.1539    19.3143    18.5325    15.9922    14.8191    17.0051    17.2082    20.5545    21.8911    23.7723 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     11.6740    10.5442    11.6740    11.2974    11.6740    11.2974    11.6740    11.6740    11.2974    11.6740    11.2974    11.6740 (61)
Total heat required for water heating calculated for each month
              175.3195   153.6696   159.3666   140.0594   135.2242   117.9118   110.4679   125.0415   126.0188   145.3708   157.2379   170.1559 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =      0.0000 (63)
FGHRS         -51.9620   -42.6692   -39.6917   -29.1995   -22.1247    -7.6762    -7.1132    -8.1625    -8.2599   -28.9559   -40.4824   -52.0319 eq.(G2)
Output from w/h
              123.3574   111.0004   119.6749   110.8599   113.0994   110.2356   103.3547   116.8790   117.7589   116.4148   116.7555   118.1240 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =   1377.5146 (64)
Heat gains from water heating, kWh/month
               57.3306    50.2253    52.0263    45.6377    43.9989    38.2736    35.7675    40.6132    40.9692    47.3727    51.3496    55.6137 (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      139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957   139.1957 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               25.9088    23.0120    18.7146    14.1682    10.5909     8.9413     9.6613    12.5582    16.8556    21.4020    24.9793    26.6289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              264.7132   267.4601   260.5380   245.8017   227.1998   209.7166   198.0367   195.2898   202.2119   216.9482   235.5501   253.0333 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196    36.9196 (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)
             -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566  -111.3566 (71)
Water heating gains (Table 5)
               77.0573    74.7400    69.9278    63.3857    59.1383    53.1578    48.0746    54.5876    56.9017    63.6730    71.3188    74.7496 (72)
Total internal gains
              435.4380   432.9707   416.9391   391.1143   364.6877   339.5744   323.5313   330.1943   343.7279   369.7819   399.6070   422.1706 (73)
```

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6. Solar gains

```
[Jan]                                        Area          Solar flux              g                FF            Access            Gains
                                             m2            Table 6a      Specific data      Specific data      factor                W
                                                             W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
East                                       3.2400           19.6403            0.6300             0.7000        0.7700           19.4475 (76)
South                                      5.4000           46.7521            0.6300             0.7000        0.7700           77.1554 (78)
West                                       1.6200           19.6403            0.6300             0.7000        0.7700            9.7238 (80)
West                                       2.5100           26.6072            0.7400             0.7000        1.0000           31.1348 (82)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    137.4615   246.3713   363.7015   485.6614   569.0117   574.0559   549.7760   487.4171   406.5546   280.0327   167.0153   116.0291 (83)
Total gains    572.8995   679.3421   780.6406   876.7756   933.6993   913.6302   873.3073   817.6114   750.2825   649.8145   566.6223   538.1997 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          24.4351    24.4958    24.5555    24.8402    24.8942    25.1487    25.1487    25.1964    25.0500    24.8942    24.7852    24.6723
alpha         2.6290     2.6331     2.6370     2.6560     2.6596     2.6766     2.6766     2.6798     2.6700     2.6596     2.6523     2.6448
util living area
               0.9773     0.9638     0.9389     0.8892     0.8053     0.6798     0.5488     0.5924     0.7788     0.9166     0.9664     0.9806 (86)

MIT           18.4767    18.7548    19.2098    19.7946    20.3197    20.7086    20.8831    20.8528    20.5449    19.8491    19.0577    18.4287 (87)
Th 2          19.8988    19.9012    19.9036    19.9147    19.9168    19.9266    19.9266    19.9284    19.9228    19.9168    19.9126    19.9082 (88)
util rest of house
               0.9735     0.9578     0.9282     0.8684     0.7654     0.6073     0.4412     0.4875     0.7195     0.8967     0.9597     0.9774 (89)
MIT 2         16.5270    16.9311    17.5888    18.4279    19.1536    19.6600    19.8508    19.8262    19.4694    18.5212    17.3811    16.4624 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1875 (91)
MIT           16.8925    17.2729    17.8927    18.6841    19.3722    19.8566    20.0443    20.0186    19.6710    18.7701    17.6954    16.8310 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  16.7425    17.1229    17.7427    18.5341    19.2222    19.7066    19.8943    19.8686    19.5210    18.6201    17.5454    16.6810 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9563     0.9349     0.8987     0.8342     0.7346     0.5904     0.4376     0.4809     0.6927     0.8640     0.9376     0.9620 (94)
Useful gains 547.8484   635.0887   701.5272   731.4176   685.8852   539.4029   382.1715   393.1974   519.7414   561.4168   531.2668   517.7264 (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
            1607.9877  1575.7024  1445.8074  1224.7437   954.1946   641.2152   413.6512   434.7215   683.3736  1017.3546  1330.8300  1597.4605 (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
              788.7437   632.0924   553.7444   355.1948   199.6222     0.0000     0.0000     0.0000     0.0000   339.2178   575.6855   803.3222 (98)
Space heating                                                                                                                    4247.6230 (98)
Space heating per m2                                                                                                 (98) / (4) =     40.3153 (99)
```

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4735.3657	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	788.7437	632.0924	553.7444	355.1948	199.6222	0.0000	0.0000	0.0000	0.0000	339.2178	575.6855	803.3222	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	879.3129	704.6738	617.3294	395.9808	222.5443	0.0000	0.0000	0.0000	0.0000	378.1692	641.7899	895.5655	(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													
	123.3574	111.0004	119.6749	110.8599	113.0994	110.2356	103.3547	116.8790	117.7589	116.4148	116.7555	118.1240	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3108	89.2703	89.1893	89.0177	88.6668	86.9000	86.9000	86.9000	86.9000	88.9676	89.2153	89.3310	(217)
Fuel for water heating, kWh/month													
	138.1215	124.3419	134.1807	124.5369	127.5556	126.8534	118.9353	134.4983	135.5108	130.8508	130.8694	132.2318	(219)
Water heating fuel used												1558.4864	(219)
Annual totals kWh/year													
Space heating fuel - main system												4735.3657	(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)	457.5577	(232)
Total delivered energy for all uses	6826.4098	(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	4735.3657	0.2160	1022.8390	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1558.4864	0.2160	336.6331	(264)
Space and water heating			1359.4720	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.5577	0.5190	237.4725	(268)
Total CO2, kg/year			1635.8695	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.5300	(273)

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

DER		15.5300	ZC1
Total Floor Area	TFA	105.3600	
Assumed number of occupants	N	2.7839	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8883	ZC2
CO2 emissions from cooking, equation (L16)		1.7636	ZC3
Total CO2 emissions		32.1819	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		32.1819	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	105.3600 (1b)	x	2.5000 (2b)	=	263.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.4000	(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) =	0.1519	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4019	(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) =	0.3416	(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	0.4355	0.4270	0.4184	0.3757	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014	(22b)
Effective ac	0.5948	0.5912	0.5875	0.5706	0.5674	0.5527	0.5527	0.5499	0.5583	0.5674	0.5738	0.5805	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Main Type 3	60.9100	10.2600	50.6500	0.1800	9.1170			(29a)
Corridor	15.9400	1.7200	14.2200	0.1800	2.5596			(29a)
Fl	41.5500	2.5100	39.0400	0.1300	5.0752			(30)
PIR	92.5200		92.5200	0.1300	12.0276			(30)
Total net area of external elements Aum(A, m2)			210.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.0970			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.7638	(36)
Total fabric heat loss (33) + (36) =	75.8608	(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	51.7044	51.3843	51.0706	49.5968	49.3211	48.0375	48.0375	47.7998	48.5319	49.3211	49.8789	50.4621	(38)
Heat transfer coeff	127.5652	127.2451	126.9314	125.4576	125.1819	123.8983	123.8983	123.6606	124.3927	125.1819	125.7397	126.3228	(39)
Average = Sum(39)m / 12 =												125.4563	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2108	1.2077	1.2047	1.1908	1.1881	1.1760	1.1760	1.1737	1.1806	1.1881	1.1934	1.1990	(40)
HLP (average)												1.1907	(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	2.7839	(42)
Average daily hot water use (litres/day)	100.3180	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3498	106.3370	102.3243	98.3116	94.2989	90.2862	90.2862	94.2989	98.3116	102.3243	106.3370	110.3498	(44)
Energy conte	163.6455	143.1254	147.6926	128.7620	123.5502	106.6144	98.7939	113.3675	114.7214	133.6968	145.9405	158.4819	(45)
Energy content (annual)										Total = Sum(45)m =		1578.3921	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5468	21.4688	22.1539	19.3143	18.5325	15.9922	14.8191	17.0051	17.2082	20.0545	21.8911	23.7723	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.4824	48.0537	44.5247	46.0088	48.0537	48.4824	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	214.6044	189.1528	198.6515	177.2444	171.6039	151.1391	144.8028	161.4212	163.2039	184.6557	195.2556	209.4408 (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												
	214.6044	189.1528	198.6515	177.2444	171.6039	151.1391	144.8028	161.4212	163.2039	184.6557	195.2556	209.4408 (64)
								Total per year (kWh/year) = Sum(64)m =				2161.1759 (64)
Heat gains from water heating, kWh/month												
	67.1519	59.0960	61.8475	54.9340	53.0939	46.5805	44.3512	49.7081	50.2655	57.1939	60.8540	65.4350 (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	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9088	23.0120	18.7146	14.1682	10.5909	8.9413	9.6613	12.5582	16.8556	21.4020	24.9793	26.6289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	264.7132	267.4601	260.5380	245.8017	227.1998	209.7166	198.0367	195.2898	202.2119	216.9482	235.5501	253.0333	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	(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)													
	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	(71)
Water heating gains (Table 5)													
	90.2579	87.9405	83.1284	76.2972	71.3627	64.6951	59.6118	66.8120	69.8132	76.8735	84.5194	87.9502	(72)
Total internal gains													
	448.6386	446.1713	430.1397	404.0257	376.9120	351.1116	335.0686	342.4187	356.6394	382.9825	412.8076	435.3712	(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	3.2400	19.6403	0.6300	0.7000	0.7700	19.4475	(76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554	(78)
West	1.6200	19.6403	0.6300	0.7000	0.7700	9.7238	(80)
West	2.5100	26.6072	0.6300	0.7000	1.0000	26.5066	(82)

Solar gains	132.8333	237.0146	347.5341	460.8848	537.5777	541.4028	518.8841	461.5986	387.3624	268.7312	161.1902	112.2578	(83)
Total gains	581.4719	683.1859	777.6738	864.9105	914.4898	892.5144	853.9527	804.0172	744.0018	651.7136	573.9978	547.6289	(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	57.3563	57.5006	57.6427	58.3198	58.4483	59.0538	59.0538	59.1673	58.8191	58.4483	58.1890	57.9204	
alpha	4.8238	4.8334	4.8428	4.8880	4.8966	4.9369	4.9369	4.9445	4.9213	4.8966	4.8793	4.8614	
util living area													
	0.9986	0.9967	0.9910	0.9714	0.9134	0.7789	0.6113	0.6646	0.8846	0.9828	0.9971	0.9990	(86)
MIT	19.6338	19.7935	20.0558	20.4003	20.7088	20.9133	20.9795	20.9694	20.8225	20.4145	19.9604	19.6083	(87)
Th 2	19.9114	19.9138	19.9162	19.9274	19.9295	19.9393	19.9393	19.9411	19.9355	19.9295	19.9253	19.9208	(88)
util rest of house													
	0.9981	0.9955	0.9877	0.9597	0.8758	0.6886	0.4774	0.5320	0.8207	0.9738	0.9958	0.9986	(89)
MIT 2	18.0893	18.3243	18.7078	19.2103	19.6322	19.8783	19.9314	19.9279	19.7858	19.2381	18.5768	18.0587	(90)
Living area fraction										fLA = Living area / (4) =		0.1875	(91)
MIT	18.3788	18.5997	18.9604	19.4333	19.8341	20.0723	20.1279	20.1231	19.9802	19.4586	18.8361	18.3492	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3788	18.5997	18.9604	19.4333	19.8341	20.0723	20.1279	20.1231	19.9802	19.4586	18.8361	18.3492	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9934	0.9834	0.9526	0.8717	0.7012	0.5025	0.5565	0.8240	0.9681	0.9939	0.9978	(94)
Useful gains	579.7630	678.6770	764.7686	823.8953	797.1924	625.8642	429.1309	447.4374	613.0350	630.9054	570.4843	546.4194	(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													
	1795.9682	1743.2217	1581.6216	1321.4852	1018.2358	678.0052	437.1005	460.4045	731.4512	1108.9380	1475.6998	1787.3653	(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													
	904.8567	715.3740	607.7386	358.2647	164.4563	0.0000	0.0000	0.0000	0.0000	355.6563	651.7551	923.2637	(98)
Space heating												4681.3656	(98)
Space heating per m2											(98) / (4) =	44.4321	(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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5012.1687	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	904.8567	715.3740	607.7386	358.2647	164.4563	0.0000	0.0000	0.0000	0.0000	355.6563	651.7551	923.2637	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	968.7973	765.9251	650.6838	383.5811	176.0774	0.0000	0.0000	0.0000	0.0000	380.7883	697.8106	988.5051	(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	214.6044	189.1528	198.6515	177.2444	171.6039	151.1391	144.8028	161.4212	163.2039	184.6557	195.2556	209.4408	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2716	88.0832	87.6831	86.7870	84.9443	80.3000	80.3000	80.3000	80.3000	86.6742	87.8527	88.3454	(217)
Fuel for water heating, kWh/month	243.1183	214.7433	226.5561	204.2292	202.0193	188.2181	180.3272	201.0226	203.2427	213.0456	222.2533	237.0705	(219)
Water heating fuel used												2535.8462	(219)
Annual totals kWh/year													
Space heating fuel - main system												5012.1687	(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)												457.5577	(232)
Total delivered energy for all uses												8080.5727	(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	5012.1687	0.2160	1082.6284	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2535.8462	0.2160	547.7428	(264)
Space and water heating			1630.3712	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.5577	0.5190	237.4725	(268)
Total CO2, kg/m2/year			1906.7687	(272)
Emissions per m2 for space and water heating			15.4743	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2539	(272b)
Emissions per m2 for pumps and fans			0.3694	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.4743 * 1.00) + 2.2539 + 0.3694, rounded to 2 d.p.			18.1000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-14	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Top
Property	Plot 14, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.46	**TER**	16.97
Environmental	86 B	**% DER<TER**	14.77		
CO_2 Emissions (t/year)	1.79	**DFEE**	45.84	**TFEE**	56.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.20		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	142.8100 (1b)	x	2.5800 (2b)	=	368.4498	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	142.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.4498	(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) =	0.1086	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3586	(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) =	0.3048	(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	0.3886	0.3810	0.3734	0.3353	0.3276	0.2895	0.2895	0.2819	0.3048	0.3276	0.3429	0.3581	(22b)
Effective ac	0.5755	0.5726	0.5697	0.5562	0.5537	0.5419	0.5419	0.5397	0.5464	0.5537	0.5588	0.5641	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			4.8600	1.3258	6.4432			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Dwarf	53.5100	4.8600	48.6500	0.1300	6.3245	9.0000	437.8500	(29a)
Corridor	18.2700	1.7200	16.5500	0.2257	3.7359	110.0000	1820.5000	(29a)
Fl	81.0400		81.0400	0.1300	10.5352	9.0000	729.3600	(30)
PIR	85.2100	2.5100	82.7000	0.1300	10.7510	9.0000	744.3000	(30)
Total net area of external elements Aum(A, m2)			238.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.1814			(33)
Party Wall 1			41.2500	0.0000	0.0000	20.0000	825.0000	(32)
Party Floor 1			142.8100			40.0000	5712.4000	(32d)
Internal Wall 1			195.9800			9.0000	1763.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.2300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		84.2604 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		35.7045 (36)
Total fabric heat loss	(33) + (36) =	78.8859 (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	69.9744	69.6179	69.2685	67.6273	67.3202	65.8908	65.8908	65.6261	66.4414	67.3202	67.9414	68.5908	(38)
Heat transfer coeff	148.8603	148.5038	148.1544	146.5132	146.2062	144.7767	144.7767	144.5120	145.3273	146.2062	146.8273	147.4768	(39)
Average = Sum(39)m / 12 =												146.5117	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0424	1.0399	1.0374	1.0259	1.0238	1.0138	1.0138	1.0119	1.0176	1.0238	1.0281	1.0327	(40)
HLP (average)												1.0259	(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		2.9223 (42)
Average daily hot water use (litres/day)		103.6035 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.9638	109.8197	105.6756	101.5314	97.3873	93.2431	93.2431	97.3873	101.5314	105.6756	109.8197	113.9638	(44)
Energy conte	169.0051	147.8129	152.5297	132.9791	127.5966	110.1062	102.0296	117.0804	118.4787	138.0755	150.7202	163.6724	(45)
Energy content (annual)										Total = Sum(45)m =		1630.0864	(45)
Distribution loss (46)m = 0.15 x (45)m													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	25.3508	22.1719	22.8795	19.9469	19.1395	16.5159	15.3044	17.5621	17.7718	20.7113	22.6080	24.5509	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)
Total heat required for water heating calculated for each month													
	180.6791	158.3572	164.2037	144.2765	139.2706	121.4036	113.7035	128.7544	129.7761	149.7495	162.0176	175.3464	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-61.0386	-51.6342	-49.9125	-37.7571	-28.7395	-7.9276	-7.3461	-8.4298	-8.5305	-36.1091	-48.1843	-60.7773	eq.(G2)
Output from w/h													
	119.6404	106.7230	114.2912	106.5194	110.5311	113.4759	106.3574	120.3246	121.2456	113.6404	113.8334	114.5690	(64)
									Total per year (kWh/year) = Sum(64)m =			1361.1515	(64)
Heat gains from water heating, kWh/month													
	59.1127	51.7839	53.6346	47.0399	45.3444	39.4347	36.8433	41.8477	42.2185	48.8286	52.9388	57.3396	(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	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.7421	31.7458	25.8174	19.5455	14.6105	12.3348	13.3281	17.3244	23.2528	29.5248	34.4598	36.7355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	312.5849	315.8286	307.6547	290.2534	268.2874	247.6425	233.8504	230.6068	238.7807	256.1819	278.1479	298.7928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	(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)													
	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	(71)
Water heating gains (Table 5)													
	79.4525	77.0593	72.0895	65.3332	60.9467	54.7703	49.5206	56.2469	58.6368	65.6298	73.5261	77.0693	(72)
Total internal gains													
	497.6133	494.4675	475.3954	444.9658	413.6784	384.5814	366.5330	374.0119	390.5041	421.1704	455.9676	482.4314	(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	4.8600	10.6334	0.6300	0.7000	0.7700	15.7936	(74)
North	1.8800	15.6897	0.7400	0.7000	1.0000	13.7513	(82)
West	0.6300	26.2379	0.7400	0.7000	1.0000	7.7062	(82)

Solar gains	37.2511	71.4445	124.0043	205.8520	284.1598	307.2624	285.6475	222.3313	151.0230	85.5542	45.9520	31.0821	(83)
Total gains	534.8645	565.9120	599.3997	650.8178	697.8382	691.8438	652.1804	596.3432	541.5271	506.7245	501.9196	513.5135	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.4544	22.5083	22.5613	22.8141	22.8620	23.0877	23.0877	23.1300	23.0002	22.8620	22.7653	22.6650	
alpha	2.4970	2.5006	2.5041	2.5209	2.5241	2.5392	2.5392	2.5420	2.5333	2.5241	2.5177	2.5110	
util living area													
	0.9830	0.9791	0.9702	0.9479	0.9001	0.8128	0.7090	0.7555	0.8911	0.9575	0.9778	0.9847	(86)
MIT	18.1749	18.3501	18.7375	19.3231	19.9377	20.4690	20.7454	20.6874	20.2428	19.4967	18.7532	18.1470	(87)
Th 2	20.0482	20.0502	20.0523	20.0618	20.0636	20.0719	20.0719	20.0734	20.0687	20.0636	20.0600	20.0562	(88)
util rest of house													
	0.9806	0.9761	0.9655	0.9386	0.8790	0.7642	0.6192	0.6748	0.8595	0.9483	0.9741	0.9826	(89)
MIT 2	16.2068	16.4635	17.0297	17.8849	18.7676	19.5092	19.8609	19.7990	19.2117	18.1430	17.0582	16.1701	(90)
Living area fraction										fLA = Living area / (4) =		0.2591	(91)
MIT	16.7167	16.9523	17.4721	18.2575	19.0708	19.7579	20.0901	20.0292	19.4789	18.4937	17.4973	16.6823	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.5667	16.8023	17.3221	18.1075	18.9208	19.6079	19.9401	19.8792	19.3289	18.3437	17.3473	16.5323	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9666	0.9598	0.9450	0.9107	0.8447	0.7340	0.6041	0.6541	0.8255	0.9229	0.9571	0.9697	(94)
Useful gains	516.9935	543.1890	566.4071	592.7277	589.4384	507.8429	394.0004	390.0965	447.0099	467.6313	480.3812	497.9346	(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													
	1826.0316	1767.5317	1603.3483	1349.0252	1055.7233	725.0225	483.5656	502.7796	759.8954	1132.1752	1504.5874	1818.7267	(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													
	973.9243	822.7583	771.4843	544.5342	346.9160	0.0000	0.0000	0.0000	0.0000	494.4207	737.4285	982.6693	(98)
Space heating												5674.1356	(98)
Space heating per m2											(98) / (4) =	39.7321	(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)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6325.6807	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	973.9243	822.7583	771.4843	544.5342	346.9160	0.0000	0.0000	0.0000	0.0000	494.4207	737.4285	982.6693	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1085.7573	917.2333	860.0717	607.0615	386.7514	0.0000	0.0000	0.0000	0.0000	551.1936	822.1054	1095.5065	(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													
	119.6404	106.7230	114.2912	106.5194	110.5311	113.4759	106.3574	120.3246	121.2456	113.6404	113.8334	114.5690	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.3849	89.3694	89.3286	89.2296	89.0070	86.9000	86.9000	86.9000	86.9000	89.1631	89.3152	89.3992	(217)
Fuel for water heating, kWh/month													
	133.8486	119.4178	127.9447	119.3768	124.1825	130.5822	122.3906	138.4633	139.5232	127.4523	127.4513	128.1544	(219)
Water heating fuel used												1538.7876	(219)
Annual totals kWh/year													
Space heating fuel - main system												6325.6807	(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)												631.2167	(232)
Total delivered energy for all uses												8570.6850	(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	6325.6807	0.2160	1366.3470	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1538.7876	0.2160	332.3781	(264)
Space and water heating			1698.7252	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	631.2167	0.5190	327.6015	(268)
Total CO2, kg/year			2065.2516	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.4600	(273)

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

DER		14.4600	ZC1
Total Floor Area	TFA	142.8100	
Assumed number of occupants	N	2.9223	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.9705	ZC2
CO2 emissions from cooking, equation (L16)		1.3244	ZC3
Total CO2 emissions		28.7548	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		28.7548	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	142.8100 (1b)	x	2.5800 (2b)	=	368.4498	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	142.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.4498	(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) =	0.1086	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3586	(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) =	0.3048	(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	0.3886	0.3810	0.3734	0.3353	0.3276	0.2895	0.2895	0.2819	0.3048	0.3276	0.3429	0.3581	(22b)
Effective ac	0.5755	0.5726	0.5697	0.5562	0.5537	0.5419	0.5419	0.5397	0.5464	0.5537	0.5588	0.5641	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			4.8600	1.3258	6.4432			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Dwarf	53.5100	4.8600	48.6500	0.1800	8.7570			(29a)
Corridor	18.2700	1.7200	16.5500	0.1800	2.9790			(29a)
Fl	81.0400		81.0400	0.1300	10.5352			(30)
PIR	85.2100	2.5100	82.7000	0.1300	10.7510			(30)
Total net area of external elements Aum(A, m2)			238.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.1807			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							27.7638	(36)
Total fabric heat loss					(33) + (36) =		72.9445	(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	69.9744	69.6179	69.2685	67.6273	67.3202	65.8908	65.8908	65.6261	66.4414	67.3202	67.9414	68.5908	(38)
Heat transfer coeff	142.9189	142.5624	142.2130	140.5718	140.2647	138.8353	138.8353	138.5706	139.3859	140.2647	140.8859	141.5353	(39)
Average = Sum(39)m / 12 =												140.5703	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0008	0.9983	0.9958	0.9843	0.9822	0.9722	0.9722	0.9703	0.9760	0.9822	0.9865	0.9911	(40)
HLP (average)												0.9843	(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												2.9223	(42)
Average daily hot water use (litres/day)												103.6035	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.9638	109.8197	105.6756	101.5314	97.3873	93.2431	93.2431	97.3873	101.5314	105.6756	109.8197	113.9638	(44)
Energy conte	169.0051	147.8129	152.5297	132.9791	127.5966	110.1062	102.0296	117.0804	118.4787	138.0755	150.7202	163.6724	(45)
Energy content (annual)										Total = Sum(45)m =		1630.0864	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3508	22.1719	22.8795	19.9469	19.1395	16.5159	15.3044	17.5621	17.7718	20.7113	22.6080	24.5509	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.6275	45.9829	47.5157	49.6275	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	219.9640	193.8403	203.4886	182.2942	177.2241	156.0891	149.5452	166.7079	167.7938	189.0344	200.0353	214.6313	(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													
	219.9640	193.8403	203.4886	182.2942	177.2241	156.0891	149.5452	166.7079	167.7938	189.0344	200.0353	214.6313	(64)
								Total per year (kWh/year) = Sum(64)m =				2220.6482	(64)
Heat gains from water heating, kWh/month													
	68.9339	60.6546	63.4559	56.5443	54.8327	48.1060	45.8037	51.3361	51.7229	58.6498	62.4432	67.1608	(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	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.7421	31.7458	25.8174	19.5455	14.6105	12.3348	13.3281	17.3244	23.2528	29.5248	34.4598	36.7355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	312.5849	315.8286	307.6547	290.2534	268.2874	247.6425	233.8504	230.6068	238.7807	256.1819	278.1479	298.7928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	(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)													
	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	(71)
Water heating gains (Table 5)													
	92.6531	90.2599	85.2901	78.5338	73.6999	66.8139	61.5642	69.0001	71.8374	78.8304	86.7267	90.2699	(72)
Total internal gains													
	510.8139	507.6681	488.5960	458.1664	426.4316	396.6250	378.5765	386.7651	403.7047	434.3709	469.1682	495.6320	(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	4.8600	10.6334	0.6300	0.7000	0.7700	15.7936	(74)
North	1.8800	15.6897	0.6300	0.7000	1.0000	11.7072	(82)
West	0.6300	26.2379	0.6300	0.7000	1.0000	6.5607	(82)

Solar gains	34.0615	65.3109	113.1950	187.4981	258.4159	279.2478	259.6738	202.3627	137.7399	78.1773	42.0174	28.4189	(83)
Total gains	544.8754	572.9790	601.7910	645.6645	684.8475	675.8728	638.2503	589.1278	541.4446	512.5483	511.1857	524.0509	(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	69.3915	69.5650	69.7360	70.5501	70.7046	71.4326	71.4326	71.5690	71.1504	70.7046	70.3928	70.0699	
alpha	5.6261	5.6377	5.6491	5.7033	5.7136	5.7622	5.7622	5.7713	5.7434	5.7136	5.6929	5.6713	
util living area													
	0.9998	0.9997	0.9993	0.9975	0.9879	0.9413	0.8328	0.8837	0.9835	0.9984	0.9996	0.9999	(86)
MIT	19.7548	19.8351	20.0116	20.2834	20.5740	20.8285	20.9461	20.9206	20.7085	20.3576	20.0190	19.7445	(87)
Th 2	20.0827	20.0848	20.0868	20.0964	20.0982	20.1066	20.1066	20.1081	20.1034	20.0982	20.0946	20.0908	(88)
util rest of house													
	0.9997	0.9996	0.9991	0.9963	0.9806	0.8992	0.7175	0.7883	0.9694	0.9974	0.9995	0.9998	(89)
MIT 2	18.3887	18.5078	18.7678	19.1722	19.5951	19.9505	20.0778	20.0590	19.7931	19.2824	18.7843	18.3796	(90)
Living area fraction									fLA = Living area / (4) =			0.2591	(91)
MIT	18.7427	18.8516	19.0900	19.4601	19.8487	20.1780	20.3028	20.2822	20.0303	19.5610	19.1042	18.7332	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7427	18.8516	19.0900	19.4601	19.8487	20.1780	20.3028	20.2822	20.0303	19.5610	19.1042	18.7332	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9994	0.9986	0.9951	0.9778	0.9035	0.7468	0.8110	0.9678	0.9965	0.9992	0.9997	(94)
Useful gains	544.6521	572.6129	600.9459	642.4902	669.6506	610.6229	476.6654	477.7669	523.9922	510.7394	510.7928	523.8835	(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													
	2064.1278	1988.9803	1790.4667	1484.4470	1142.9760	774.4233	514.0772	537.9570	826.5959	1256.9097	1691.2232	2056.9643	(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													
	1130.4899	951.7989	885.0035	606.2089	352.1541	0.0000	0.0000	0.0000	0.0000	555.1507	849.9099	1140.6121	(98)
Space heating												6471.3279	(98)
Space heating per m2											(98) / (4) =	45.3142	(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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6928.6166	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1130.4899	951.7989	885.0035	606.2089	352.1541	0.0000	0.0000	0.0000	0.0000	555.1507	849.9099	1140.6121	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1210.3746	1019.0566	947.5412	649.0459	377.0387	0.0000	0.0000	0.0000	0.0000	594.3798	909.9678	1221.2121	(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													
	219.9640	193.8403	203.4886	182.2942	177.2241	156.0891	149.5452	166.7079	167.7938	189.0344	200.0353	214.6313	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.5852	88.5162	88.3232	87.8456	86.7473	80.3000	80.3000	80.3000	80.3000	87.6012	88.2844	88.6344	(217)
Fuel for water heating, kWh/month													
	248.3080	218.9884	230.3909	207.5166	204.2994	194.3824	186.2332	207.6063	208.9586	215.7898	226.5805	242.1534	(219)
Water heating fuel used												2591.2076	(219)
Annual totals kWh/year													
Space heating fuel - main system												6928.6166	(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)												631.2167	(232)
Total delivered energy for all uses												10226.0409	(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	6928.6166	0.2160	1496.5812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2591.2076	0.2160	559.7008	(264)
Space and water heating			2056.2820	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	631.2167	0.5190	327.6015	(268)
Total CO2, kg/m2/year			2422.8085	(272)
Emissions per m2 for space and water heating			14.3987	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2940	(272b)
Emissions per m2 for pumps and fans			0.2726	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.3987 * 1.00) + 2.2940 + 0.2726, rounded to 2 d.p.			16.9700	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-15	**Issued on Date**	21/09/2021
Assessment Reference	001-1	**Prop Type Ref**	HT Top
Property	Plot 15, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	14.35	**TER**	16.41
Environmental	86 B	**% DER<TER**	12.58		
CO_2 Emissions (t/year)	1.88	**DFEE**	47.21	**TFEE**	55.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.37		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	150.7800 (1b)	x	2.6400 (2b)	=	398.0592	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	398.0592	(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) =	0.1256	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3756	(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) =	0.3193	(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	0.4071	0.3991	0.3911	0.3512	0.3432	0.3033	0.3033	0.2953	0.3193	0.3432	0.3592	0.3751	(22b)
Effective ac	0.5829	0.5796	0.5765	0.5617	0.5589	0.5460	0.5460	0.5436	0.5510	0.5589	0.5645	0.5704	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
Velux (Uw = 1.40)			3.1400	1.3258	4.1629			(27a)
Dwarf	62.9700	10.2600	52.7100	0.1300	6.8523	9.0000	474.3900	(29a)
Corridor	21.4700	1.7200	19.7500	0.2257	4.4582	110.0000	2172.5000	(29a)
Fl	79.5700		79.5700	0.1300	10.3441	9.0000	716.1300	(30)
PIR	98.2600	3.1400	95.1200	0.1300	12.3656	9.0000	856.0800	(30)
Total net area of external elements Aum(A, m2)			262.2700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.8494			(33)
Party Wall 1			25.9100	0.0000	0.0000	20.0000	518.2000	(32)
Party Floor 1			150.7800			40.0000	6031.2000	(32d)
Internal Wall 1			247.2700			9.0000	2225.4300	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		12993.9300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							86.1781	(35)
Thermal bridges (User defined value 0.150 * total exposed area)							39.3405	(36)
Total fabric heat loss					(33) + (36) =		93.1899	(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	76.5631	76.1405	75.7263	73.7806	73.4165	71.7219	71.7219	71.4081	72.3746	73.4165	74.1530	74.9229	(38)
Heat transfer coeff	169.7530	169.3304	168.9162	166.9705	166.6064	164.9118	164.9118	164.5980	165.5645	166.6064	167.3429	168.1128	(39)
Average = Sum(39)m / 12 =												166.9687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1258	1.1230	1.1203	1.1074	1.1050	1.0937	1.0937	1.0916	1.0981	1.1050	1.1098	1.1150	(40)
HLP (average)												1.1074	(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												2.9354	(42)
Average daily hot water use (litres/day)												103.9157	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3073	110.1507	105.9940	101.8374	97.6808	93.5242	93.5242	97.6808	101.8374	105.9940	110.1507	114.3073	(44)
Energy conte	169.5144	148.2584	152.9894	133.3799	127.9811	110.4380	102.3370	117.4332	118.8358	138.4916	151.1744	164.1657	(45)
Energy content (annual)										Total = Sum(45)m =		1634.9990	(45)
Distribution loss (46)m = 0.15 x (45)m													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	25.4272	22.2388	22.9484	20.0070	19.1972	16.5657	15.3506	17.6150	17.8254	20.7737	22.6762	24.6248	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	11.6740	10.5442	11.6740	11.2974	11.6740	11.2974	11.6740	11.6740	11.2974	11.6740	11.2974	11.6740	(61)
Total heat required for water heating calculated for each month													
	181.1884	158.8026	164.6634	144.6773	139.6551	121.7354	114.0110	129.1072	130.1332	150.1656	162.4718	175.8396	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-64.7066	-55.2315	-52.3229	-38.6004	-28.7684	-7.9515	-7.3683	-8.4552	-8.5562	-37.5036	-51.8364	-64.3402	eq.(G2)
Output from w/h													
	116.4818	103.5712	112.3404	106.0769	110.8868	113.7839	106.6428	120.6520	121.5770	112.6621	110.6354	111.4995	(64)
								Total per year (kWh/year) = Sum(64)m =				1346.8097	(64)
Heat gains from water heating, kWh/month													
	59.2820	51.9320	53.7875	47.1732	45.4722	39.5450	36.9456	41.9650	42.3372	48.9670	53.0899	57.5036	(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	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.5736	29.8198	24.2511	18.3596	13.7240	11.5864	12.5195	16.2733	21.8421	27.7335	32.3691	34.5067	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3698	324.7046	316.3009	298.4106	275.8273	254.6022	240.4225	237.0877	245.4913	263.3816	285.9649	307.1901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	(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)													
	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	(71)
Water heating gains (Table 5)													
	79.6802	77.2797	72.2950	65.5183	61.1186	54.9236	49.6580	56.4046	58.8017	65.8158	73.7359	77.2898	(72)
Total internal gains													
	504.6545	501.8351	482.8780	452.3195	420.7009	391.1432	372.6310	379.7967	396.1661	426.9619	462.1009	489.0175	(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	7.0200	10.6334	0.6300	0.7000	0.7700	22.8129	(74)
South	3.2400	46.7521	0.6300	0.7000	0.7700	46.2932	(78)
East	3.1400	26.2379	0.7400	0.7000	1.0000	38.4089	(82)

Solar gains	107.5151	196.5108	302.6148	428.5993	526.9263	543.1655	515.3672	439.3175	346.0147	226.4555	131.2567	90.3834	(83)
Total gains	612.1696	698.3458	785.4928	880.9188	947.6272	934.3087	887.9982	819.1142	742.1808	653.4174	593.3577	579.4009	(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	21.2628	21.3159	21.3681	21.6171	21.6644	21.8870	21.8870	21.9287	21.8007	21.6644	21.5690	21.4703	
alpha	2.4175	2.4211	2.4245	2.4411	2.4443	2.4591	2.4591	2.4619	2.4534	2.4443	2.4379	2.4314	
util living area													
	0.9806	0.9722	0.9560	0.9211	0.8569	0.7528	0.6362	0.6827	0.8430	0.9405	0.9731	0.9830	(86)
MIT	18.0856	18.3270	18.7802	19.4121	20.0305	20.5351	20.7879	20.7384	20.3188	19.5299	18.7053	18.0470	(87)
Th 2	19.9798	19.9821	19.9843	19.9948	19.9968	20.0060	20.0060	20.0077	20.0024	19.9968	19.9928	19.9886	(88)
util rest of house													
	0.9778	0.9682	0.9491	0.9074	0.8282	0.6941	0.5377	0.5905	0.8003	0.9276	0.9685	0.9806	(89)
MIT 2	16.0387	16.3912	17.0512	17.9687	18.8464	19.5359	19.8432	19.7944	19.2625	18.1493	16.9506	15.9870	(90)
Living area fraction									fLA = Living area / (4) =			0.2583	(91)
MIT	16.5675	16.8913	17.4978	18.3416	19.1523	19.7940	20.0872	20.0383	19.5354	18.5059	17.4039	16.5191	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.4175	16.7413	17.3478	18.1916	19.0023	19.6440	19.9372	19.8883	19.3854	18.3559	17.2539	16.3691	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9619	0.9479	0.9225	0.8734	0.7920	0.6686	0.5299	0.5775	0.7663	0.8968	0.9486	0.9662	(94)
Useful gains	588.8387	661.9492	724.5861	769.3821	750.5080	624.6442	470.5729	473.0037	568.7325	585.9700	562.8336	559.8107	(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													
	2056.9744	2005.0897	1832.3712	1551.4182	1216.6052	831.8232	550.3447	574.1651	875.0671	1292.1849	1699.1744	2045.7878	(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													
	1092.2929	902.5904	824.1921	563.0660	346.7763	0.0000	0.0000	0.0000	0.0000	525.4239	818.1653	1105.5670	(98)
Space heating												6178.0739	(98)
Space heating per m2											(98) / (4) =	40.9741	(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)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6887.4848	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1092.2929	902.5904	824.1921	563.0660	346.7763	0.0000	0.0000	0.0000	0.0000	525.4239	818.1653	1105.5670	(98)
Space heating efficiency (main heating system 1)													
	89.7000	89.7000	89.7000	89.7000	89.7000	0.0000	0.0000	0.0000	0.0000	89.7000	89.7000	89.7000	(210)
Space heating fuel (main heating system)													
	1217.7178	1006.2323	918.8317	627.7213	386.5957	0.0000	0.0000	0.0000	0.0000	585.7568	912.1130	1232.5161	(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													
	116.4818	103.5712	112.3404	106.0769	110.8868	113.7839	106.6428	120.6520	121.5770	112.6621	110.6354	111.4995	(64)
Efficiency of water heater												86.9000	(216)
(217)m	89.4224	89.4035	89.3546	89.2442	89.0052	86.9000	86.9000	86.9000	86.9000	89.1926	89.3570	89.4360	(217)
Fuel for water heating, kWh/month													
	130.2603	115.8469	125.7242	118.8614	124.5847	130.9365	122.7189	138.8401	139.9045	126.3133	123.8128	124.6696	(219)
Water heating fuel used												1522.4732	(219)
Annual totals kWh/year													
Space heating fuel - main system												6887.4848	(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)												592.9203	(232)
Total delivered energy for all uses												9077.8784	(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	6887.4848	0.2160	1487.6967	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1522.4732	0.2160	328.8542	(264)
Space and water heating			1816.5509	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	592.9203	0.5190	307.7257	(268)
Total CO2, kg/year			2163.2016	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.3500	(273)

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

DER		14.3500	ZC1
Total Floor Area	TFA	150.7800	
Assumed number of occupants	N	2.9354	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6301	ZC2
CO2 emissions from cooking, equation (L16)		1.2565	ZC3
Total CO2 emissions		28.2366	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		28.2366	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	150.7800 (1b)	x	2.6400 (2b)	=	398.0592	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	398.0592	(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) =	0.1005	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3505	(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) =	0.2979	(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	0.3798	0.3724	0.3649	0.3277	0.3203	0.2830	0.2830	0.2756	0.2979	0.3203	0.3352	0.3500	(22b)
Effective ac	0.5721	0.5693	0.5666	0.5537	0.5513	0.5400	0.5400	0.5380	0.5444	0.5513	0.5562	0.5613	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
TER Room Window (Uw = 1.70)			3.1400	1.5918	4.9981			(27a)
Dwarf	62.9700	10.2600	52.7100	0.1800	9.4878			(29a)
Corridor	21.4700	1.7200	19.7500	0.1800	3.5550			(29a)
Fl	79.5700		79.5700	0.1300	10.3441			(30)
PIR	98.2600	3.1400	95.1200	0.1300	12.3656			(30)
Total net area of external elements Aum(A, m2)			262.2700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0729			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.7638	(36)
Total fabric heat loss (33) + (36) =	83.8367	(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	75.1560	74.7880	74.4273	72.7332	72.4162	70.9407	70.9407	70.6674	71.5090	72.4162	73.0574	73.7278	(38)
Heat transfer coeff	158.9927	158.6247	158.2640	156.5699	156.2529	154.7774	154.7774	154.5041	155.3457	156.2529	156.8941	157.5645	(39)
Average = Sum(39)m / 12 =												156.5684	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0545	1.0520	1.0496	1.0384	1.0363	1.0265	1.0265	1.0247	1.0303	1.0363	1.0406	1.0450	(40)
HLP (average)												1.0384	(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	2.9354 (42)
Average daily hot water use (litres/day)	103.9157 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3073	110.1507	105.9940	101.8374	97.6808	93.5242	93.5242	97.6808	101.8374	105.9940	110.1507	114.3073	(44)
Energy conte	169.5144	148.2584	152.9894	133.3799	127.9811	110.4380	102.3370	117.4332	118.8358	138.4916	151.1744	164.1657	(45)
Energy content (annual)										Total = Sum(45)m =		1634.9990	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4272	22.2388	22.9484	20.0070	19.1972	16.5657	15.3506	17.6150	17.8254	20.7737	22.6762	24.6248	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.7771	46.1215	47.6589	49.7771	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	220.4733	194.2858	203.9483	182.6949	177.7582	156.5595	149.9959	167.2103	168.1508	189.4505	200.4895	215.1246	(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													
	220.4733	194.2858	203.9483	182.6949	177.7582	156.5595	149.9959	167.2103	168.1508	189.4505	200.4895	215.1246	(64)
								Total per year (kWh/year) = Sum(64)m =				2226.1417	(64)
Heat gains from water heating, kWh/month													
	69.1033	60.8028	63.6087	56.6776	54.9980	48.2510	45.9418	51.4908	51.8417	58.7882	62.5943	67.3248	(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	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.5736	29.8198	24.2511	18.3596	13.7240	11.5864	12.5195	16.2733	21.8421	27.7335	32.3691	34.5067	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3698	324.7046	316.3009	298.4106	275.8273	254.6022	240.4225	237.0877	245.4913	263.3816	285.9649	307.1901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	(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)													
	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	(71)
Water heating gains (Table 5)													
	92.8807	90.4803	85.4956	78.7188	73.9220	67.0153	61.7497	69.2081	72.0023	79.0164	86.9365	90.4903	(72)
Total internal gains													
	517.8551	515.0356	496.0786	465.5201	433.5044	403.2349	384.7227	392.6001	409.3667	440.1625	475.3015	502.2181	(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	7.0200	10.6334	0.6300	0.7000	0.7700	22.8129	(74)
South	3.2400	46.7521	0.6300	0.7000	0.7700	46.2932	(78)
East	3.1400	26.2379	0.6300	0.7000	1.0000	32.6995	(82)

Solar gains	101.8056	185.0503	282.9996	398.8023	489.3350	504.2045	478.4720	408.3473	322.8167	212.6632	124.0858	85.7212	(83)
Total gains	619.6607	700.0859	779.0781	864.3223	922.8394	907.4394	863.1948	800.9474	732.1834	652.8257	599.3873	587.9393	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.8573	66.0101	66.1605	66.8764	67.0121	67.6509	67.6509	67.7706	67.4034	67.0121	66.7382	66.4543	
alpha	5.3905	5.4007	5.4107	5.4584	5.4675	5.5101	5.5101	5.5180	5.4936	5.4675	5.4492	5.4303	
util living area													
	0.9997	0.9993	0.9981	0.9925	0.9678	0.8809	0.7316	0.7918	0.9574	0.9959	0.9994	0.9998	(86)
MIT	19.7096	19.8241	20.0374	20.3409	20.6438	20.8782	20.9685	20.9512	20.7638	20.3799	19.9947	19.6923	(87)
Th 2	20.0382	20.0402	20.0422	20.0515	20.0532	20.0613	20.0613	20.0628	20.0582	20.0532	20.0497	20.0460	(88)
util rest of house													
	0.9996	0.9991	0.9973	0.9890	0.9507	0.8148	0.6028	0.6725	0.9262	0.9935	0.9991	0.9997	(89)
MIT 2	18.2901	18.4591	18.7726	19.2216	19.6546	19.9625	20.0470	20.0374	19.8275	19.2814	18.7159	18.2705	(90)
Living area fraction									fLA = Living area / (4) =			0.2583	(91)
MIT	18.6568	18.8117	19.0993	19.5107	19.9102	20.1990	20.2850	20.2734	20.0693	19.5652	19.0462	18.6378	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6568	18.8117	19.0993	19.5107	19.9102	20.1990	20.2850	20.2734	20.0693	19.5652	19.0462	18.6378	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9986	0.9962	0.9862	0.9474	0.8263	0.6362	0.7027	0.9267	0.9917	0.9986	0.9995	(94)
Useful gains	619.2606	699.1156	776.1331	852.4338	874.3043	749.7735	549.2037	562.8311	678.5387	647.4246	598.5697	587.6584	(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													
	2282.6218	2206.7445	1994.0153	1661.3215	1282.8627	866.6045	570.3554	598.4608	927.3111	1400.8359	1874.2946	2274.8839	(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													
	1237.5408	1013.1266	906.1044	582.3992	303.9675	0.0000	0.0000	0.0000	0.0000	560.5380	918.5220	1255.2958	(98)
Space heating												6777.4942	(98)
Space heating per m2											(98) / (4) =	44.9496	(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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7256.4177	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1237.5408	1013.1266	906.1044	582.3992	303.9675	0.0000	0.0000	0.0000	0.0000	560.5380	918.5220	1255.2958	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1324.9901	1084.7180	970.1332	623.5537	325.4470	0.0000	0.0000	0.0000	0.0000	600.1478	983.4282	1343.9998	(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													
	220.4733	194.2858	203.9483	182.6949	177.7582	156.5595	149.9959	167.2103	168.1508	189.4505	200.4895	215.1246	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.7127	88.6067	88.3581	87.7641	86.3904	80.3000	80.3000	80.3000	80.3000	87.6162	88.4077	88.7666	(217)
Fuel for water heating, kWh/month													
	248.5250	219.2677	230.8201	208.1660	205.7615	194.9682	186.7944	208.2320	209.4033	216.2277	226.7783	242.3487	(219)
Water heating fuel used												2597.2928	(219)
Annual totals kWh/year													
Space heating fuel - main system												7256.4177	(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)												592.9203	(232)
Total delivered energy for all uses												10521.6309	(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	7256.4177	0.2160	1567.3862	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.2928	0.2160	561.0152	(264)
Space and water heating			2128.4015	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	592.9203	0.5190	307.7257	(268)
Total CO2, kg/m2/year			2475.0521	(272)
Emissions per m2 for space and water heating			14.1159	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0409	(272b)
Emissions per m2 for pumps and fans			0.2582	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1159 * 1.00) + 2.0409 + 0.2582, rounded to 2 d.p.			16.4100	(273)

Appendix 2: 'Be Lean' GLA SAP 10 Spreadsheet

Be Lean - SAP 2012 Methodology SAP 10 Carbon Factors

Project	London School of Theology, Northwood (Trinity House)
Client	
Date	Oct-21
Rev	A

SAP 2012	Carbon Factor	SAP 10	Carbon Factor
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

Residential Accommodation

TER

Plot	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps & Fans	Lighting	Emissions
1	3	147.5	GND	6432	2600	75	543	2040.7
2	2	146.2	GND	6645	2597	75	537	2083.4
3	2	135.3	GND	5907	2594	75	503	1919.9
4	3	150.9	MID	5648	2609	75	565	1883.1
5	2	104.8	MID	3275	2552	75	481	1353.2
6	2	114.8	MID	4109	2576	75	459	1528.3
7	2	121.0	GND	4450	2584	75	520	1615.8
8	2	131.2	MID	4913	2599	75	502	1712.0
9	2	144.4	MID	4684	2613	75	562	1680.8
10	2	115.2	MID	4052	2576	75	498	1525.4
11	2	95.6	MID	4073	2498	75	429	1497.3
12	2	96.3	MID	4136	2500	75	455	1517.1
13	2	105.4	TOP	5012	2536	75	458	1709.3
14	2	142.8	TOP	6929	2591	75	631	2163.7
15	2	150.8	TOP	7256	2597	75	593	2224.8
		1902.3						**26454.6**

DER - Based on Gas Heating with SAP 10 Carbon Factors

Plot	Space Htg	Water Htg	Pumps & Fans	Lighting	Emissions
1	6737	1529	75	543	1879.9
2	6893	1521	75	537	1909.5
3	5993	1554	75	503	1719.5
4	5308	1591	75	565	1597.9
5	3283	1627	75	481	1160.6
6	4109	1612	75	459	1325.8
7	4672	1595	75	520	1454.7
8	5390	1573	75	502	1596.7
9	4675	1616	75	562	1469.5
10	3874	1622	75	498	1287.7
11	3758	1572	75	429	1236.7
12	3872	1568	75	455	1265.9
13	4735	1559	75	458	1445.9
14	6326	1539	75	631	1816.1
15	6888	1523	75	593	1922.0
					23088.6

Total Site Target Emissions	**26,455**	$kgCO_2$ per year
Total Site Design Emissions (Be Lean)	**23,089**	$kgCO_2$ per year
Total Reduction	**3,366**	$kgCO_2$ per year
% Reduction	**12.72%**	

Appendix 3 – SAP Worksheets for units using Communal Air Source Heat Pumps

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-01	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT LGF
Property	Plot 1, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	12.22	**TER**	22.23
Environmental	89 B	**% DER<TER**	45.03		
CO_2 Emissions (t/year)	1.48	**DFEE**	44.30	**TFEE**	51.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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)	
Basement floor	147.5400 (1a)	x	2.5000 (2a)	=	368.8500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.8500	(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) =	0.1356	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3856	(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) =	0.3277	(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	0.4178	0.4097	0.4015	0.3605	0.3523	0.3113	0.3113	0.3031	0.3277	0.3523	0.3687	0.3851	(22b)
Effective ac	0.5873	0.5839	0.5806	0.5650	0.5621	0.5485	0.5485	0.5459	0.5537	0.5621	0.5680	0.5741	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			19.6200	1.3258	26.0114			(27)
GF			147.5400	0.1300	19.1802	75.0000	11065.5000	(28a)
Main Type 3	95.9700	19.6200	76.3500	0.1700	12.9795	110.0000	8398.5000	(29a)
Corridor	4.2300	1.9500	2.2800	0.2257	0.5147	110.0000	250.8000	(29a)
Total net area of external elements Aum(A, m2)			247.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.0257			(33)
Party Wall 1			22.3500	0.0000	0.0000	20.0000	447.0000	(32)
Party Ceilings 1			147.5400			30.0000	4426.2000	(32b)
Internal Wall 1			245.1000			75.0000	18382.5000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	42970.5000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		291.2464 (35)
Thermal bridges (User defined value 0.051 * total exposed area)		12.6347 (36)
Total fabric heat loss	(33) + (36) =	73.6605 (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	71.4862	71.0736	70.6691	68.7695	68.4140	66.7595	66.7595	66.4531	67.3968	68.4140	69.1331	69.8848	(38)
Heat transfer coeff	145.1467	144.7341	144.3296	142.4299	142.0745	140.4199	140.4199	140.1135	141.0573	142.0745	142.7935	143.5452	(39)
Average = Sum(39)m / 12 =												142.4282	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9838	0.9810	0.9782	0.9654	0.9630	0.9517	0.9517	0.9497	0.9561	0.9630	0.9678	0.9729	(40)
HLP (average)												0.9654	(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	2.9303 (42)
Average daily hot water use (litres/day)	103.7941 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1735	110.0217	105.8699	101.7182	97.5664	93.4147	93.4147	97.5664	101.7182	105.8699	110.0217	114.1735	(44)
Energy conte	169.3160	148.0848	152.8103	133.2237	127.8313	110.3087	102.2172	117.2958	118.6966	138.3295	150.9975	163.9735	(45)
Energy content (annual)										Total = Sum(45)m =		1633.0847	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3974	22.2127	22.9215	19.9836	19.1747	16.5463	15.3326	17.5944	17.8045	20.7494	22.6496	24.5960	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	214.8984	189.2560	198.3927	177.3357	173.4137	154.4207	147.7996	162.8782	162.8086	183.9119	195.1095	209.5559	(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													
	214.8984	189.2560	198.3927	177.3357	173.4137	154.4207	147.7996	162.8782	162.8086	183.9119	195.1095	209.5559	(64)
Total per year (kWh/year) = Sum(64)m =												2169.7807	(64)
Heat gains from water heating, kWh/month													
	92.7635	82.1752	87.2753	79.5865	78.9698	71.9672	70.4531	75.4668	74.7562	82.4605	85.4963	90.9871	(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	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.7432	27.3059	22.2066	16.8118	12.5670	10.6096	11.4641	14.9014	20.0007	25.3955	29.6403	31.5977	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	317.8339	321.1320	312.8209	295.1274	272.7926	251.8010	237.7773	234.4792	242.7903	260.4838	282.8186	303.8102	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	(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)													
	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	(71)
Water heating gains (Table 5)													
	124.6821	122.2845	117.3056	110.5368	106.1422	99.9545	94.6951	101.4338	103.8281	110.8340	118.7448	122.2945	(72)
Total internal gains													
	540.2134	537.6765	519.2872	489.4302	458.4560	429.3192	410.8906	417.7686	433.5733	463.6674	498.1578	524.6565	(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	16.3000	10.6334	0.6300	0.7000	0.7700	52.9702	(74)
West	3.2300	19.6403	0.6300	0.7000	0.7700	19.9277	(80)

Solar gains	72.8979	140.2115	236.2114	369.9264	486.9436	515.9114	483.8321	391.1966	281.4807	166.7559	90.1930	60.5461	(83)
Total gains	613.1112	677.8880	755.4986	859.3566	945.3996	945.2307	894.7227	808.9652	715.0540	630.4233	588.3509	585.2026	(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	82.2358	82.4702	82.7013	83.8044	84.0140	85.0039	85.0039	85.1898	84.6199	84.0140	83.5910	83.1532	
alpha	6.4824	6.4980	6.5134	6.5870	6.6009	6.6669	6.6669	6.6793	6.6413	6.6009	6.5727	6.5435	
util living area													
	0.9999	0.9998	0.9992	0.9949	0.9661	0.8466	0.6713	0.7537	0.9622	0.9979	0.9998	0.9999	(86)
MIT	19.9522	20.0434	20.2252	20.4960	20.7632	20.9427	20.9900	20.9798	20.8342	20.5074	20.1898	19.9413	(87)
Th 2	20.0969	20.0992	20.1015	20.1123	20.1143	20.1237	20.1237	20.1255	20.1201	20.1143	20.1102	20.1060	(88)
util rest of house													
	0.9999	0.9997	0.9988	0.9921	0.9466	0.7701	0.5482	0.6326	0.9310	0.9965	0.9996	0.9999	(89)
MIT 2	18.6733	18.8087	19.0764	19.4796	19.8587	20.0831	20.1201	20.1167	19.9639	19.4991	19.0314	18.6643	(90)
Living area fraction										fLA = Living area / (4) =		0.1239	(91)
MIT	18.8318	18.9616	19.2187	19.6055	19.9708	20.1896	20.2279	20.2237	20.0718	19.6240	19.1750	18.8226	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8318	18.9616	19.2187	19.6055	19.9708	20.1896	20.2279	20.2237	20.0718	19.6240	19.1750	18.8226	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9995	0.9982	0.9899	0.9425	0.7767	0.5635	0.6474	0.9287	0.9953	0.9994	0.9998	(94)
Useful gains	612.9667	677.5308	754.1273	850.6605	891.0099	734.1271	504.2206	523.6992	664.0790	627.4533	588.0202	585.1036	(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													
	2109.2370	2035.1987	1835.6908	1524.7820	1175.0687	784.8912	509.4232	535.7461	842.3598	1282.0790	1724.2253	2098.9989	(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													
	1113.2251	912.3528	804.6832	485.3675	211.3397	0.0000	0.0000	0.0000	0.0000	487.0415	818.0677	1126.3381	(98)
Space heating												5958.4156	(98)
Space heating per m2											(98) / (4) =	40.3851	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	5958.4156	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	6256.3364	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2169.7807	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2278.2698	(310a)
Electricity used for heat distribution	85.3461	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	542.9349	(332)
Total delivered energy for all uses	9077.5411	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2844.8687	0.5190	1476.4869	(367)
Electrical energy for heat distribution	85.3461	0.5190	44.2946	(372)
Total CO2 associated with community systems			1520.7815	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1520.7815	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	542.9349	0.5190	281.7832	(379)
Total CO2, kg/year			1802.5647	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2200	(384)

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

DER		12.2200	ZC1
Total Floor Area	TFA	147.5400	
Assumed number of occupants	N	2.9303	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.7655	ZC2
CO2 emissions from cooking, equation (L16)		1.2832	ZC3
Total CO2 emissions		26.2687	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		26.2687	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)	
Basement floor	147.5400 (1a)	x	2.5000 (2a)	=	368.8500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.8500	(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) =	0.1084	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3584	(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) =	0.3047	(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	0.3885	0.3808	0.3732	0.3351	0.3275	0.2894	0.2894	0.2818	0.3047	0.3275	0.3428	0.3580	(22b)
Effective ac	0.5755	0.5725	0.5697	0.5562	0.5536	0.5419	0.5419	0.5397	0.5464	0.5536	0.5587	0.5641	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			19.6200	1.3258	26.0114			(27)
GF			147.5400	0.1300	19.1802			(28a)
Main Type 3	95.9700	19.6200	76.3500	0.1800	13.7430			(29a)
Corridor	4.2300	1.9500	2.2800	0.1800	0.4104			(29a)
Total net area of external elements Aum(A, m2)			247.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.2950			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.6036	(36)
Total fabric heat loss (33) + (36) =	74.8986	(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	70.0444	69.6877	69.3382	67.6963	67.3891	65.9590	65.9590	65.6942	66.5098	67.3891	68.0105	68.6602	(38)
Heat transfer coeff	144.9429	144.5863	144.2367	142.5948	142.2876	140.8576	140.8576	140.5927	141.4084	142.2876	142.9091	143.5588	(39)
Average = Sum(39)m / 12 =												142.5933	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9824	0.9800	0.9776	0.9665	0.9644	0.9547	0.9547	0.9529	0.9584	0.9644	0.9686	0.9730	(40)
HLP (average)												0.9665	(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	2.9303 (42)
Average daily hot water use (litres/day)	103.7941 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1735	110.0217	105.8699	101.7182	97.5664	93.4147	93.4147	97.5664	101.7182	105.8699	110.0217	114.1735	(44)
Energy conte	169.3160	148.0848	152.8103	133.2237	127.8313	110.3087	102.2172	117.2958	118.6966	138.3295	150.9975	163.9735	(45)
Energy content (annual)										Total = Sum(45)m =		1633.0847	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3974	22.2127	22.9215	19.9836	19.1747	16.5463	15.3326	17.5944	17.8045	20.7494	22.6496	24.5960	(46)

Water storage loss:	
Store volume	180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8381 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss

	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)

If cylinder contains dedicated solar storage

	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (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

	218.5586	192.5621	202.0529	180.8779	177.0740	157.9629	151.4599	166.5384	166.3508	187.5722	198.6517	213.2161 (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

	218.5586	192.5621	202.0529	180.8779	177.0740	157.9629	151.4599	166.5384	166.3508	187.5722	198.6517	213.2161 (64)
								Total per year (kWh/year) = Sum(64)m =				2212.8775 (64)

Heat gains from water heating, kWh/month

	95.6917	84.8200	90.2035	82.4202	81.8980	74.8010	73.3814	78.3950	77.5900	85.3887	88.3300	93.9153 (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	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	146.5138	(66)

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

	30.7432	27.3059	22.2066	16.8118	12.5670	10.6096	11.4641	14.9014	20.0007	25.3955	29.6403	31.5977 (67)

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

	317.8339	321.1320	312.8209	295.1274	272.7926	251.8010	237.7773	234.4792	242.7903	260.4838	282.8186	303.8102 (68)

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

	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514	37.6514 (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)

	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110	-117.2110 (71)

Water heating gains (Table 5)

	128.6179	126.2202	121.2413	114.4725	110.0780	103.8903	98.6309	105.3696	107.7639	114.7697	122.6806	126.2303 (72)

Total internal gains

	547.1491	544.6123	526.2230	496.3659	465.3918	436.2550	417.8264	424.7044	440.5090	470.6032	505.0936	531.5923 (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	16.3000	10.6334	0.6300	0.7000	0.7700	52.9702	(74)
West	3.2000	19.6403	0.6300	0.7000	0.7700	19.9277	(80)

Solar gains	72.8979	140.2115	236.2114	369.9264	486.9436	515.9114	483.8321	391.1966	281.4807	166.7559	90.1930	60.5461 (83)
Total gains	620.0470	684.8238	762.4344	866.2924	952.3354	952.1664	901.6585	815.9010	721.9898	637.3591	595.2866	592.1384 (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	70.6887	70.8631	71.0348	71.8528	72.0079	72.7390	72.7390	72.8760	72.4556	72.0079	71.6948	71.3703	
alpha	5.7126	5.7242	5.7357	5.7902	5.8005	5.8493	5.8493	5.8584	5.8304	5.8005	5.7797	5.7580	
util living area	0.9997	0.9994	0.9981	0.9907	0.9534	0.8297	0.6614	0.7398	0.9485	0.9957	0.9993	0.9998	(86)
MIT	19.8177	19.9204	20.1256	20.4289	20.7264	20.9264	20.9845	20.9715	20.8081	20.4432	20.0840	19.8030	(87)
Th 2	20.0980	20.1000	20.1020	20.1114	20.1131	20.1212	20.1212	20.1228	20.1181	20.1131	20.1096	20.1059	(88)
util rest of house	0.9996	0.9991	0.9973	0.9866	0.9312	0.7557	0.5425	0.6236	0.9138	0.9933	0.9991	0.9997	(89)
MIT 2	18.4920	18.6439	18.9455	19.3937	19.8137	20.0650	20.1146	20.1086	19.9334	19.4178	18.8904	18.4764	(90)
Living area fraction									fLA = Living area / (4) =			0.1239	(91)
MIT	18.6563	18.8021	19.0917	19.5220	19.9268	20.1717	20.2224	20.2155	20.0418	19.5449	19.0383	18.6407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6563	18.8021	19.0917	19.5220	19.9268	20.1717	20.2224	20.2155	20.0418	19.5449	19.0383	18.6407	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9986	0.9960	0.9828	0.9253	0.7605	0.5569	0.6370	0.9099	0.9909	0.9985	0.9995	(94)
Useful gains	619.6153	683.8728	759.3799	851.3613	881.2034	724.1431	502.1503	519.7454	656.9369	631.5460	594.4039	591.8273	(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	2080.8384	2010.0484	1816.1883	1514.6408	1170.5755	784.8228	510.2398	536.4360	840.2147	1272.7449	1706.0908	2073.0946	(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	1087.1500	891.1900	786.2654	477.5613	215.2928	0.0000	0.0000	0.0000	0.0000	477.0520	800.4146	1102.0629	(98)
Space heating												5836.9890	(98)
Space heating per m2											(98) / (4) =	39.5621	(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												6242.7690	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1087.1500	891.1900	786.2654	477.5613	215.2928	0.0000	0.0000	0.0000	0.0000	477.0520	800.4146	1102.0629	(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)													
	1162.7273	953.1444	840.9256	510.7607	230.2597	0.0000	0.0000	0.0000	0.0000	510.2161	856.0584	1178.6769	(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													
	218.5586	192.5621	202.0529	180.8779	177.0740	157.9629	151.4599	166.5384	166.3508	187.5722	198.6517	213.2161	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5134	88.3941	88.0854	87.2849	85.3361	79.8000	79.8000	79.8000	79.8000	87.2002	88.1498	88.5747	(217)
Fuel for water heating, kWh/month													
	246.9215	217.8450	229.3831	207.2269	207.5018	197.9485	189.7994	208.6948	208.4597	215.1052	225.3568	240.7189	(219)
Water heating fuel used												2594.9617	(219)
Annual totals kWh/year													
Space heating fuel - main system												6242.7690	(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)												542.9349	(232)
Total delivered energy for all uses												9455.6656	(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	6242.7690	0.2160	1348.4381	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2594.9617	0.2160	560.5117	(264)
Space and water heating			1908.9498	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	542.9349	0.5190	281.7832	(268)
Total CO2, kg/m2/year			2229.6581	(272)
Emissions per m2 for space and water heating			12.9385	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.9099	(272b)
Emissions per m2 for pumps and fans			0.2638	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.9385 * 1.55) + 1.9099 + 0.2638, rounded to 2 d.p.			22.2300	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-02	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT LGF
Property	Plot 2, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	84 B	**DER**	12.48	**TER**	22.89
Environmental	89 B	**% DER<TER**	45.47		
CO_2 Emissions (t/year)	1.50	**DFEE**	45.30	**TFEE**	52.81
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.22		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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)	
Basement floor	146.1800 (1a)	x	2.5000 (2a)	=	365.4500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4500	(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) =	0.1368	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3868	(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) =	0.3288	(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	0.4192	0.4110	0.4028	0.3617	0.3535	0.3124	0.3124	0.3041	0.3288	0.3535	0.3699	0.3863	(22b)
Effective ac	0.5879	0.5845	0.5811	0.5654	0.5625	0.5488	0.5488	0.5462	0.5541	0.5625	0.5684	0.5746	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			20.0300	1.3258	26.5549			(27)
GF			146.1800	0.1200	17.5416	75.0000	10963.5000	(28a)
Main Type 3	92.4900	20.0300	72.4600	0.1700	12.3182	110.0000	7970.6000	(29a)
Corridor	9.0600	1.9500	7.1100	0.2257	1.6050	110.0000	782.1000	(29a)
Total net area of external elements Aum(A, m2)			247.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.3597			(33)
Party Wall 1			21.9000	0.0000	0.0000	20.0000	438.0000	(32)
Party Ceilings 1			146.1800			30.0000	4385.4000	(32b)
Internal Wall 1			246.9000			75.0000	18517.5000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		43057.1000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							294.5485	(35)
Thermal bridges (User defined value 0.049 * total exposed area)							12.1388	(36)
Total fabric heat loss					(33) + (36) =		72.4985	(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	70.8962	70.4847	70.0814	68.1869	67.8324	66.1824	66.1824	65.8768	66.8180	67.8324	68.5495	69.2992	(38)
Heat transfer coeff	143.3947	142.9832	142.5799	140.6854	140.3309	138.6809	138.6809	138.3753	139.3164	140.3309	141.0480	141.7976	(39)
Average = Sum(39)m / 12 =												140.6837	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9809	0.9781	0.9754	0.9624	0.9600	0.9487	0.9487	0.9466	0.9530	0.9600	0.9649	0.9700	(40)
HLP (average)												0.9624	(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		2.9280 (42)
Average daily hot water use (litres/day)		103.7410 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1151	109.9655	105.8158	101.6662	97.5166	93.3669	93.3669	97.5166	101.6662	105.8158	109.9655	114.1151	(44)
Energy conte	169.2294	148.0092	152.7322	133.1556	127.7660	110.2523	102.1650	117.2358	118.6360	138.2588	150.9203	163.8897	(45)
Energy content (annual)										Total = Sum(45)m =		1632.2503	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3844	22.2014	22.9098	19.9733	19.1649	16.5379	15.3247	17.5854	17.7954	20.7388	22.6380	24.5835	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	214.8118	189.1804	198.3146	177.2676	173.3484	154.3643	147.7474	162.8182	162.7480	183.8412	195.0323	209.4721	(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													
	214.8118	189.1804	198.3146	177.2676	173.3484	154.3643	147.7474	162.8182	162.7480	183.8412	195.0323	209.4721	(64)
Total per year (kWh/year) = Sum(64)m =												2168.9463	(64)
Heat gains from water heating, kWh/month													
	92.7347	82.1500	87.2494	79.5638	78.9481	71.9485	70.4358	75.4468	74.7361	82.4370	85.4706	90.9592	(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	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.3974	26.9987	21.9568	16.6227	12.4257	10.4903	11.3351	14.7338	19.7757	25.1098	29.3069	31.2423	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	316.3358	319.6183	311.3463	293.7363	271.5067	250.6141	236.6565	233.3739	241.6459	259.2560	281.4855	302.3782	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	37.6402	(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)													
	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	-117.1217	(71)
Water heating gains (Table 5)													
	124.6434	122.2470	117.2707	110.5053	106.1131	99.9285	94.6717	101.4070	103.8001	110.8024	118.7092	122.2570	(72)
Total internal gains													
	538.2973	535.7847	517.4945	487.7850	456.9661	427.9535	409.5840	416.4354	432.1424	462.0888	496.4222	522.7982	(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	20.0300	10.6334	0.6300	0.7000	0.7700	65.0915	(74)

Solar gains	65.0915	124.3933	211.3746	339.5218	457.3669	489.6249	457.1274	362.6723	254.1407	148.0740	80.2988	54.2635	(83)
Total gains	603.3888	660.1780	728.8691	827.3068	914.3330	917.5784	866.7114	779.1077	686.2831	610.1628	576.7210	577.0617	(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	83.4083	83.6483	83.8850	85.0146	85.2293	86.2434	86.2434	86.4338	85.8499	85.2293	84.7960	84.3477	
alpha	6.5606	6.5766	6.5923	6.6676	6.6820	6.7496	6.7496	6.7623	6.7233	6.6820	6.6531	6.6232	
util living area													
	0.9999	0.9998	0.9993	0.9958	0.9703	0.8560	0.6832	0.7689	0.9679	0.9983	0.9998	0.9999	(86)
MIT	19.9632	20.0492	20.2243	20.4900	20.7573	20.9406	20.9895	20.9782	20.8273	20.5062	20.1969	19.9534	(87)
Th 2	20.0992	20.1016	20.1039	20.1148	20.1168	20.1263	20.1263	20.1281	20.1226	20.1168	20.1127	20.1084	(88)
util rest of house													
	0.9999	0.9997	0.9990	0.9935	0.9525	0.7810	0.5590	0.6478	0.9402	0.9971	0.9997	0.9999	(89)
MIT 2	18.6902	18.8180	19.0760	19.4721	19.8530	20.0839	20.1224	20.1185	19.9576	19.4983	19.0428	18.6828	(90)
Living area fraction									fLA = Living area / (4) =			0.2846	(91)
MIT	19.0526	19.1685	19.4029	19.7619	20.1104	20.3277	20.3692	20.3632	20.2052	19.7852	19.3713	19.0445	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0526	19.1685	19.4029	19.7619	20.1104	20.3277	20.3692	20.3632	20.2052	19.7852	19.3713	19.0445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9996	0.9986	0.9923	0.9524	0.8004	0.5951	0.6831	0.9436	0.9964	0.9996	0.9999	(94)
Useful gains	603.2738	659.9105	727.8846	820.9063	870.7887	734.4432	515.7484	532.2393	647.5911	607.9848	576.4642	576.9823	(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													
	2115.4421	2040.1500	1839.6902	1528.1082	1180.2354	794.3272	522.7215	548.4126	850.5494	1288.9686	1730.8394	2104.9082	(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													
	1125.0532	927.5210	827.1833	509.1854	230.2284	0.0000	0.0000	0.0000	0.0000	506.6520	831.1501	1136.7769	(98)
Space heating												6093.7501	(98)
Space heating per m2											(98) / (4) =	41.6866	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	6093.7501	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	6398.4377	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2168.9463	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2277.3937	(310a)
Electricity used for heat distribution	86.7583	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	536.8282	(332)
Total delivered energy for all uses	9212.6595	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2891.9438	0.5190	1500.9188	(367)
Electrical energy for heat distribution	86.7583	0.5190	45.0276	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1545.9464	(373)
Space and water heating			1545.9464	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	536.8282	0.5190	278.6138	(379)
Total CO2, kg/year			1824.5602	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.4800	(384)

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

DER		12.4800	ZC1
Total Floor Area	TFA	146.1800	
Assumed number of occupants	N	2.9280	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.8235	ZC2
CO2 emissions from cooking, equation (L16)		1.2948	ZC3
Total CO2 emissions		26.5983	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		26.5983	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)	
Basement floor	146.1800 (1a)	x	2.5000 (2a)	=	365.4500	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	365.4500	(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) =	0.1095	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3595	(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) =	0.3055	(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	0.3896	0.3819	0.3743	0.3361	0.3285	0.2903	0.2903	0.2826	0.3055	0.3285	0.3437	0.3590	(22b)
Effective ac	0.5759	0.5729	0.5700	0.5565	0.5539	0.5421	0.5421	0.5399	0.5467	0.5539	0.5591	0.5644	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			20.0300	1.3258	26.5549			(27)
GF			146.1800	0.1300	19.0034			(28a)
Main Type 3	92.4900	20.0300	72.4600	0.1800	13.0428			(29a)
Corridor	9.0600	1.9500	7.1100	0.1800	1.2798			(29a)
Total net area of external elements Aum(A, m2)			247.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.8309			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.0259	(36)
Total fabric heat loss					(33) + (36) =		74.8568	(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	69.4500	69.0947	68.7464	67.1104	66.8043	65.3795	65.3795	65.1156	65.9283	66.8043	67.4235	68.0709	(38)
Heat transfer coeff	144.3068	143.9515	143.6032	141.9672	141.6612	140.2363	140.2363	139.9724	140.7851	141.6612	142.2804	142.9277	(39)
Average = Sum(39)m / 12 =												141.9658	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9872	0.9848	0.9824	0.9712	0.9691	0.9593	0.9593	0.9575	0.9631	0.9691	0.9733	0.9778	(40)
HLP (average)												0.9712	(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		2.9280 (42)
Average daily hot water use (litres/day)		103.7410 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.1151	109.9655	105.8158	101.6662	97.5166	93.3669	93.3669	97.5166	101.6662	105.8158	109.9655	114.1151	(44)
Energy conte	169.2294	148.0092	152.7322	133.1556	127.7660	110.2523	102.1650	117.2358	118.6360	138.2588	150.9203	163.8897	(45)
Energy content (annual)										Total = Sum(45)m =		1632.2503	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3844	22.2014	22.9098	19.9733	19.1649	16.5379	15.3247	17.5854	17.7954	20.7388	22.6380	24.5835	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (56)
If cylinder contains dedicated solar storage
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (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
218.4721 192.4864 201.9749 180.8098 177.0087 157.9065 151.4077 166.4785 166.2902 187.5015 198.5745 213.1323 (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
218.4721 192.4864 201.9749 180.8098 177.0087 157.9065 151.4077 166.4785 166.2902 187.5015 198.5745 213.1323 (64)
Total per year (kWh/year) = Sum(64)m = 2212.0431 (64)
Heat gains from water heating, kWh/month
95.6629 84.7948 90.1776 82.3976 81.8763 74.7823 73.3640 78.3750 77.5698 85.3652 88.3044 93.8875 (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	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	146.4022	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
30.3974 26.9987 21.9568 16.6227 12.4257 10.4903 11.3351 14.7338 19.7757 25.1098 29.3069 31.2423 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
316.3358 319.6183 311.3463 293.7363 271.5067 250.6141 236.6565 233.3739 241.6459 259.2560 281.4855 302.3782 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 37.6402 (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)
-117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 -117.1217 (71)
Water heating gains (Table 5)
128.5792 126.1828 121.2064 114.4411 110.0488 103.8642 98.6075 105.3428 107.7359 114.7382 122.6449 126.1928 (72)
Total internal gains
545.2330 542.7205 524.4303 494.7208 463.9019 434.8893 416.5198 423.3712 439.0782 469.0246 503.3580 529.7339 (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	20.0300	10.6334	0.6300	0.7000	0.7700	65.0915	(74)

Solar gains 65.0915 124.3933 211.3746 339.5218 457.3669 489.6249 457.1274 362.6723 254.1407 148.0740 80.2988 54.2635 (83)
Total gains 610.3246 667.1138 735.8049 834.2426 921.2688 924.5141 873.6472 786.0435 693.2189 617.0986 583.6568 583.9975 (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	70.3459	70.5195	70.6905	71.5051	71.6596	72.3877	72.3877	72.5242	72.1055	71.6596	71.3478	71.0246	
alpha	5.6897	5.7013	5.7127	5.7670	5.7773	5.8258	5.8258	5.8349	5.8070	5.7773	5.7565	5.7350	
util living area	0.9997	0.9994	0.9983	0.9920	0.9582	0.8406	0.6761	0.7570	0.9551	0.9962	0.9994	0.9998	(86)
MIT	19.8084	19.9064	20.1069	20.4088	20.7112	20.9199	20.9825	20.9675	20.7943	20.4296	20.0744	19.7946	(87)
Th 2	20.0940	20.0961	20.0980	20.1074	20.1092	20.1174	20.1174	20.1189	20.1142	20.1092	20.1056	20.1019	(88)
util rest of house	0.9996	0.9992	0.9976	0.9884	0.9378	0.7681	0.5556	0.6407	0.9237	0.9940	0.9991	0.9997	(89)
MIT 2	18.4754	18.6205	18.9152	19.3618	19.7907	20.0554	20.1097	20.1024	19.9132	19.3953	18.8734	18.4611	(90)
Living area fraction									fLA = Living area / (4) =			0.2846	(91)
MIT	18.8548	18.9865	19.2544	19.6598	20.0527	20.3014	20.3581	20.3486	20.1640	19.6897	19.2153	18.8407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8548	18.9865	19.2544	19.6598	20.0527	20.3014	20.3581	20.3486	20.1640	19.6897	19.2153	18.8407	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9988	0.9967	0.9859	0.9361	0.7851	0.5902	0.6738	0.9260	0.9925	0.9987	0.9995	(94)
Useful gains	609.9420	666.3223	733.3948	822.4794	862.4354	725.8065	515.6621	529.6059	641.8949	612.4808	582.8991	583.7184	(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	2100.3620	2027.7768	1831.5732	1527.5439	1183.2531	799.5494	527.0271	552.7020	853.7160	1287.6569	1723.7670	2092.5594	(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	1108.8724	914.8975	817.0448	507.6465	238.6883	0.0000	0.0000	0.0000	0.0000	502.3310	821.4249	1122.5777	(98)
Space heating												6033.4831	(98)
Space heating per m2											(98) / (4) =	41.2743	(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												6452.9231	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1108.8724	914.8975	817.0448	507.6465	238.6883	0.0000	0.0000	0.0000	0.0000	502.3310	821.4249	1122.5777	(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)													
	1185.9598	978.5000	873.8447	542.9374	255.2816	0.0000	0.0000	0.0000	0.0000	537.2524	878.5293	1200.6179	(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													
	218.4721	192.4864	201.9749	180.8098	177.0087	157.9065	151.4077	166.4785	166.2902	187.5015	198.5745	213.1323	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5458	88.4388	88.1571	87.4215	85.6120	79.8000	79.8000	79.8000	79.8000	87.3177	88.1977	88.6043	(217)
Fuel for water heating, kWh/month													
	246.7334	217.6493	229.1079	206.8254	206.7569	197.8779	189.7339	208.6197	208.3837	214.7348	225.1470	240.5441	(219)
Water heating fuel used												2592.1140	(219)
Annual totals kWh/year													
Space heating fuel - main system												6452.9231	(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)												536.8282	(232)
Total delivered energy for all uses												9656.8653	(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	6452.9231	0.2160	1393.8314	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2592.1140	0.2160	559.8966	(264)
Space and water heating			1953.7280	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	536.8282	0.5190	278.6138	(268)
Total CO2, kg/m2/year			2271.2668	(272)
Emissions per m2 for space and water heating			13.3652	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.9060	(272b)
Emissions per m2 for pumps and fans			0.2663	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.3652 * 1.55) + 1.9060 + 0.2663, rounded to 2 d.p.			22.8900	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-03	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT GF
Property	Plot 3, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	12.24	**TER**	22.81
Environmental	89 B	**% DER<TER**	46.33		
CO_2 Emissions (t/year)	1.36	**DFEE**	44.12	**TFEE**	51.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.99		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	135.3300 (1b)	x	2.6600 (2b)	=	359.9778	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	135.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	359.9778	(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) =	0.1111	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3611	(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) =	0.3070	(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	0.3914	0.3837	0.3760	0.3376	0.3300	0.2916	0.2916	0.2839	0.3070	0.3300	0.3453	0.3607	(22b)
Effective ac	0.5766	0.5736	0.5707	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
GF			135.3300	0.1200	16.2396	75.0000	10149.7500	(28a)
Main Type 3	107.1700	21.0000	86.1700	0.1700	14.6489	110.0000	9478.7000	(29a)
Corridor	3.3500	1.9500	1.4000	0.2257	0.3160	110.0000	154.0000	(29a)
Total net area of external elements Aum(A, m2)			245.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.3854			(33)
Party Wall 1			33.5800	0.0000	0.0000	20.0000	671.6000	(32)
Party Ceilings 1			135.3300			30.0000	4059.9000	(32b)
Internal Wall 1			228.2800			75.0000	17121.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	41634.9500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		307.6550 (35)
Thermal bridges (User defined value 0.060 * total exposed area)		14.7510 (36)
Total fabric heat loss	(33) + (36) =	76.1364 (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	68.4937	68.1404	67.7942	66.1678	65.8635	64.4469	64.4469	64.1846	64.9926	65.8635	66.4791	67.1226	(38)
Heat transfer coeff	144.6301	144.2769	143.9306	142.3042	141.9999	140.5834	140.5834	140.3210	141.1290	141.9999	142.6155	143.2591	(39)
Average = Sum(39)m / 12 =												142.3028	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0687	1.0661	1.0636	1.0515	1.0493	1.0388	1.0388	1.0369	1.0429	1.0493	1.0538	1.0586	(40)
HLP (average)												1.0515	(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	2.9076 (42)
Average daily hot water use (litres/day)	103.2558 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.5814	109.4511	105.3209	101.1907	97.0604	92.9302	92.9302	97.0604	101.1907	105.3209	109.4511	113.5814	(44)
Energy conte	168.4379	147.3168	152.0178	132.5328	127.1684	109.7366	101.6871	116.6875	118.0811	137.6121	150.2144	163.1231	(45)
Energy content (annual)										Total = Sum(45)m =		1624.6156	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2657	22.0975	22.8027	19.8799	19.0753	16.4605	15.2531	17.5031	17.7122	20.6418	22.5322	24.4685	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	214.0203	188.4880	197.6002	176.6448	172.7508	153.8486	147.2695	162.2699	162.1931	183.1945	194.3264	208.7055	(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													
	214.0203	188.4880	197.6002	176.6448	172.7508	153.8486	147.2695	162.2699	162.1931	183.1945	194.3264	208.7055	(64)
Total per year (kWh/year) = Sum(64)m =												2161.3116	(64)
Heat gains from water heating, kWh/month													
	92.4715	81.9198	87.0118	79.3568	78.7494	71.7770	70.2769	75.2645	74.5516	82.2219	85.2359	90.7043	(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	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.4524	25.2712	20.5519	15.5591	11.6306	9.8191	10.6098	13.7911	18.5103	23.5031	27.4316	29.2432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.0365	307.1915	299.2411	282.3157	260.9504	240.8701	227.4552	224.3003	232.2506	249.1760	270.5413	290.6216	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	(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)													
	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	(71)
Water heating gains (Table 5)													
	124.2897	121.9045	116.9514	110.2177	105.8460	99.6903	94.4582	101.1620	103.5438	110.5134	118.3832	121.9144	(72)
Total internal gains													
	523.3927	520.9813	503.3585	474.7067	445.0412	416.9937	399.1374	405.8675	420.9190	449.8067	482.9702	508.3934	(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	8.8400	19.6403	0.6300	0.7000	0.7700	53.0605	(76)
South	4.2200	46.7521	0.6300	0.7000	0.7700	63.1531	(78)
West	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(80)

Solar gains	162.6716	298.1078	452.3586	616.4947	728.2169	735.9455	704.3864	621.4210	510.5095	342.5607	198.9458	136.4093	(83)
Total gains	686.0643	819.0891	955.7171	1091.2014	1173.2581	1152.9392	1103.5238	1027.2885	931.4285	792.3674	681.9161	644.8027	(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	79.9644	80.1602	80.3530	81.2714	81.4456	82.2662	82.2662	82.4200	81.9482	81.4456	81.0940	80.7297	
alpha	6.3310	6.3440	6.3569	6.4181	6.4297	6.4844	6.4844	6.4947	6.4632	6.4297	6.4063	6.3820	
util living area													
	0.9998	0.9991	0.9962	0.9797	0.9108	0.7397	0.5547	0.6165	0.8845	0.9915	0.9993	0.9998	(86)
MIT	19.9720	20.1054	20.3249	20.6109	20.8498	20.9720	20.9961	20.9928	20.9105	20.5879	20.2249	19.9510	(87)
Th 2	20.0265	20.0286	20.0307	20.0406	20.0425	20.0511	20.0511	20.0527	20.0478	20.0425	20.0387	20.0348	(88)
util rest of house													
	0.9996	0.9988	0.9945	0.9698	0.8695	0.6481	0.4385	0.4962	0.8170	0.9858	0.9989	0.9998	(89)
MIT 2	18.6433	18.8401	19.1620	19.5804	19.8989	20.0344	20.0500	20.0502	19.9792	19.5537	19.0229	18.6189	(90)
Living area fraction										fLA = Living area / (4) =		0.2226	(91)
MIT	18.9391	19.1217	19.4208	19.8098	20.1105	20.2431	20.2605	20.2600	20.1865	19.7839	19.2904	18.9153	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9391	19.1217	19.4208	19.8098	20.1105	20.2431	20.2605	20.2600	20.1865	19.7839	19.2904	18.9153	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9982	0.9929	0.9666	0.8730	0.6678	0.4646	0.5233	0.8285	0.9837	0.9985	0.9996	(94)
Useful gains	685.6945	817.6353	948.9181	1054.8062	1024.2180	769.9901	512.6534	537.6001	771.6954	779.4193	680.8832	644.5695	(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													
	2117.2493	2051.8597	1859.6967	1552.5081	1194.2923	793.3250	514.6117	541.6417	858.9820	1304.1108	1738.5456	2108.1058	(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													
	1065.0768	829.3988	677.6193	358.3454	126.5353	0.0000	0.0000	0.0000	0.0000	390.3705	761.5169	1088.8710	(98)
Space heating												5297.7338	(98)
Space heating per m2											(98) / (4) =	39.1468	(99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	5297.7338	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	5562.6205	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2161.3116	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2269.3772	(310a)
Electricity used for heat distribution	78.3200	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	502.4781	(332)
Total delivered energy for all uses	8334.4757	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2610.6659	0.5190	1354.9356	(367)
Electrical energy for heat distribution	78.3200	0.5190	40.6481	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1395.5837	(373)
Space and water heating			1395.5837	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	502.4781	0.5190	260.7861	(379)
Total CO2, kg/year			1656.3698	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2400	(384)

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

DER		12.2400	ZC1
Total Floor Area	TFA	135.3300	
Assumed number of occupants	N	2.9076	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.3131	ZC2
CO2 emissions from cooking, equation (L16)		1.3950	ZC3
Total CO2 emissions		26.9480	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		26.9480	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	135.3300 (1b)	x	2.6600 (2b)	=	359.9778	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	135.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	359.9778	(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) =	0.1111	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3611	(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) =	0.3070	(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	0.3914	0.3837	0.3760	0.3376	0.3300	0.2916	0.2916	0.2839	0.3070	0.3300	0.3453	0.3607	(22b)
Effective ac	0.5766	0.5736	0.5707	0.5570	0.5544	0.5425	0.5425	0.5403	0.5471	0.5544	0.5596	0.5650	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
GF			135.3300	0.1300	17.5929			(28a)
Main Type 3	107.1700	21.0000	86.1700	0.1800	15.5106			(29a)
Corridor	3.3500	1.9500	1.4000	0.1800	0.2520			(29a)
Total net area of external elements Aum(A, m2)			245.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.1464			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.1299	(36)
Total fabric heat loss (33) + (36) =	79.2763	(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	68.4937	68.1404	67.7942	66.1678	65.8635	64.4469	64.4469	64.1846	64.9926	65.8635	66.4791	67.1226	(38)
Heat transfer coeff	147.7700	147.4168	147.0705	145.4441	145.1398	143.7232	143.7232	143.4609	144.2689	145.1398	145.7554	146.3989	(39)
Average = Sum(39)m / 12 =												145.4426	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0919	1.0893	1.0868	1.0747	1.0725	1.0620	1.0620	1.0601	1.0661	1.0725	1.0770	1.0818	(40)
HLP (average)												1.0747	(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	2.9076	(42)
Average daily hot water use (litres/day)	103.2558	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.5814	109.4511	105.3209	101.1907	97.0604	92.9302	92.9302	97.0604	101.1907	105.3209	109.4511	113.5814	(44)
Energy conte	168.4379	147.3168	152.0178	132.5328	127.1684	109.7366	101.6871	116.6875	118.0811	137.6121	150.2144	163.1231	(45)
Energy content (annual)										Total = Sum(45)m =		1624.6156	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2657	22.0975	22.8027	19.8799	19.0753	16.4605	15.2531	17.5031	17.7122	20.6418	22.5322	24.4685	(46)

Water storage loss:		
Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8381	(55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (56)
If cylinder contains dedicated solar storage
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (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
217.6806 191.7941 201.2605 180.1870 176.4110 157.3908 150.9298 165.9301 165.7353 186.8548 197.8686 212.3658 (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
217.6806 191.7941 201.2605 180.1870 176.4110 157.3908 150.9298 165.9301 165.7353 186.8548 197.8686 212.3658 (64)
Total per year (kWh/year) = Sum(64)m = 2204.4083 (64)
Heat gains from water heating, kWh/month
95.3997 84.5647 89.9401 82.1905 81.6776 74.6108 73.2051 78.1927 77.3853 85.1502 88.0696 93.6326 (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	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	145.3806	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.4524	25.2712	20.5519	15.5591	11.6306	9.8191	10.6098	13.7911	18.5103	23.5031	27.4316	29.2432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.0365	307.1915	299.2411	282.3157	260.9504	240.8701	227.4552	224.3003	232.2506	249.1760	270.5413	290.6216	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	37.5381	(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)													
	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	-116.3045	(71)
Water heating gains (Table 5)													
	128.2254	125.8403	120.8872	114.1535	109.7817	103.6261	98.3940	105.0977	107.4796	114.4491	122.3189	125.8502	(72)
Total internal gains													
	530.3285	527.9170	510.2943	481.6425	451.9770	423.9294	406.0732	412.8032	427.8547	456.7425	489.9060	515.3292	(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	8.8400	19.6403	0.6300	0.7000	0.7700	53.0605	(76)
South	4.4200	46.7521	0.6300	0.7000	0.7700	63.1531	(78)
West	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(80)

Solar gains	162.6716	298.1078	452.3586	616.4947	728.2169	735.9455	704.3864	621.4210	510.5095	342.5607	198.9458	136.4093	(83)
Total gains	693.0001	826.0248	962.6529	1098.1372	1180.1938	1159.8750	1110.4595	1034.2243	938.3643	799.3032	688.8518	651.7384	(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	63.5983	63.7507	63.9008	64.6153	64.7508	65.3890	65.3890	65.5085	65.1417	64.7508	64.4773	64.1939	
alpha	5.2399	5.2500	5.2601	5.3077	5.3167	5.3593	5.3593	5.3672	5.3428	5.3167	5.2985	5.2796	
util living area													
	0.9991	0.9974	0.9916	0.9676	0.8924	0.7316	0.5571	0.6161	0.8661	0.9837	0.9978	0.9993	(86)
MIT	19.7547	19.9127	20.1730	20.5093	20.7912	20.9498	20.9903	20.9840	20.8712	20.4909	20.0585	19.7294	(87)
Th 2	20.0074	20.0096	20.0117	20.0215	20.0234	20.0320	20.0320	20.0336	20.0287	20.0234	20.0196	20.0157	(88)
util rest of house													
	0.9988	0.9965	0.9885	0.9550	0.8513	0.6444	0.4410	0.4976	0.8009	0.9753	0.9969	0.9991	(89)
MIT 2	18.3340	18.5663	18.9468	19.4353	19.8138	19.9976	20.0283	20.0267	19.9215	19.4170	18.7872	18.3029	(90)
Living area fraction										fLA = Living area / (4) =		0.2226	(91)
MIT	18.6502	18.8660	19.2197	19.6743	20.0313	20.2095	20.2424	20.2398	20.1329	19.6560	19.0702	18.6203	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6502	18.8660	19.2197	19.6743	20.0313	20.2095	20.2424	20.2398	20.1329	19.6560	19.0702	18.6203	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9950	0.9850	0.9493	0.8517	0.6616	0.4670	0.5240	0.8090	0.9709	0.9956	0.9986	(94)
Useful gains	691.6690	821.9189	948.2412	1042.4516	1005.2049	767.3728	518.5398	541.9388	759.1518	776.0451	685.8124	650.8284	(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													
	2120.5324	2058.8175	1870.6916	1567.0624	1209.2045	806.2185	523.4990	550.8574	870.3556	1314.3859	1744.7154	2111.1240	(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													
	1063.0744	831.1959	686.3031	377.7197	151.7757	0.0000	0.0000	0.0000	0.0000	400.5256	762.4102	1086.4599	(98)
Space heating												5359.4645	(98)
Space heating per m2											(98) / (4) =	39.6029	(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												5732.0476	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1063.0744	831.1959	686.3031	377.7197	151.7757	0.0000	0.0000	0.0000	0.0000	400.5256	762.4102	1086.4599	(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)													
	1136.9780	888.9795	734.0140	403.9783	162.3269	0.0000	0.0000	0.0000	0.0000	428.3696	815.4119	1161.9892	(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													
	217.6806	191.7941	201.2605	180.1870	176.4110	157.3908	150.9298	165.9301	165.7353	186.8548	197.8686	212.3658	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.4835	88.2807	87.8296	86.7435	84.4157	79.8000	79.8000	79.8000	79.8000	86.7977	88.0668	88.5585	(217)
Fuel for water heating, kWh/month													
	246.0126	217.2548	229.1489	207.7238	208.9789	197.2316	189.1351	207.9325	207.6883	215.2762	224.6800	239.8029	(219)
Water heating fuel used												2590.8656	(219)
Annual totals kWh/year													
Space heating fuel - main system												5732.0476	(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)												502.4781	(232)
Total delivered energy for all uses												8900.3913	(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	5732.0476	0.2160	1238.1223	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2590.8656	0.2160	559.6270	(264)
Space and water heating			1797.7492	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	502.4781	0.5190	260.7861	(268)
Total CO2, kg/m2/year			2097.4604	(272)
Emissions per m2 for space and water heating			13.2842	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.9270	(272b)
Emissions per m2 for pumps and fans			0.2876	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.2842 * 1.55) + 1.9270 + 0.2876, rounded to 2 d.p.			22.8100	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-04	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 4, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	10.45	**TER**	20.09
Environmental	90 B	**% DER<TER**	47.98		
CO_2 Emissions (t/year)	1.32	**DFEE**	35.58	**TFEE**	43.99
General Requirements Compliance	Pass	**% DFEE<TFEE**	19.13		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	150.9100 (1b)	x	2.6600 (2b)	=	401.4206	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	401.4206	(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) =	0.0996	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3496	(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) =	0.2972	(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	0.3789	0.3715	0.3641	0.3269	0.3195	0.2823	0.2823	0.2749	0.2972	0.3195	0.3343	0.3492	(22b)
Effective ac	0.5718	0.5690	0.5663	0.5534	0.5510	0.5399	0.5399	0.5378	0.5442	0.5510	0.5559	0.5610	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			17.6000	1.3258	23.3333			(27)
GF			45.0300	0.1400	6.3042	75.0000	3377.2500	(28a)
Main Type 3	75.7000	17.6000	58.1000	0.1700	9.8770	110.0000	6391.0000	(29a)
Corridor	6.4900	1.9500	4.5400	0.2257	1.0248	110.0000	499.4000	(29a)
Total net area of external elements Aum(A, m2)			127.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.8794			(33)
Party Wall 1			69.5300	0.0000	0.0000	20.0000	1390.6000	(32)
Party Floor 1			105.8800			40.0000	4235.2000	(32d)
Party Ceilings 1			150.9100			30.0000	4527.3000	(32b)
Internal Wall 1			248.9800			9.0000	2240.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22661.5700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.1661 (35)
Thermal bridges (User defined value 0.071 * total exposed area)		9.0326 (36)
Total fabric heat loss	(33) + (36) =	51.9120 (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	75.7448	75.3755	75.0135	73.3133	72.9952	71.5143	71.5143	71.2401	72.0847	72.9952	73.6387	74.3115	(38)
Heat transfer coeff	127.6568	127.2875	126.9255	125.2253	124.9071	123.4263	123.4263	123.1521	123.9967	124.9071	125.5507	126.2235	(39)
Average = Sum(39)m / 12 =												125.2237	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8459	0.8435	0.8411	0.8298	0.8277	0.8179	0.8179	0.8161	0.8217	0.8277	0.8320	0.8364	(40)
HLP (average)												0.8298	(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	2.9356 (42)
Average daily hot water use (litres/day)	103.9205 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3125	110.1557	105.9989	101.8421	97.6853	93.5284	93.5284	97.6853	101.8421	105.9989	110.1557	114.3125	(44)
Energy conte	169.5222	148.2652	152.9964	133.3860	127.9870	110.4431	102.3417	117.4386	118.8412	138.4980	151.1814	164.1732	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0739	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4283	22.2398	22.9495	20.0079	19.1981	16.5665	15.3513	17.6158	17.8262	20.7747	22.6772	24.6260	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 0.7200 (55)
Total storage loss

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)

If cylinder contains dedicated solar storage

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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

	215.1046	189.4364	198.5788	177.4980	173.5694	154.5551	147.9241	163.0210	162.9532	184.0804	195.2934	209.7556 (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

	215.1046	189.4364	198.5788	177.4980	173.5694	154.5551	147.9241	163.0210	162.9532	184.0804	195.2934	209.7556 (64)

Total per year (kWh/year) = Sum(64)m = 2171.7699 (64)

Heat gains from water heating, kWh/month

	92.8320	82.2351	87.3372	79.6404	79.0216	72.0119	70.4945	75.5143	74.8043	82.5165	85.5574	91.0535 (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	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	(66)

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

	32.0160	28.4363	23.1259	17.5078	13.0873	11.0489	11.9387	15.5183	20.8287	26.4468	30.8673	32.9058	(67)

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

	321.5107	324.8470	316.4397	298.5415	275.9483	254.7139	240.5280	237.1917	245.5990	263.4971	286.0904	307.3248	(68)

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

	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	37.6780	(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)

	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	-117.4240	(71)

Water heating gains (Table 5)

	124.7743	122.3737	117.3887	110.6117	106.2118	100.0165	94.7507	101.4977	103.8949	110.9093	118.8297	122.3837	(72)

Total internal gains

	545.3349	542.6909	523.9883	493.6950	462.2814	432.8133	414.2514	421.2417	437.3565	467.8872	502.8214	529.6483	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)
West	7.2400	19.6403	0.6300	0.7000	0.7700	43.4568	(80)

Solar gains	77.1237	149.3499	249.3286	379.7913	486.7945	509.4041	480.3104	397.0662	294.2742	177.4598	95.7180	63.8032	(83)
Total gains	622.4586	692.0409	773.3169	873.4863	949.0759	942.2173	894.5618	818.3079	731.6307	645.3470	598.5394	593.4515	(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	49.3110	49.4540	49.5951	50.2685	50.3965	51.0011	51.0011	51.1147	50.7665	50.3965	50.1382	49.8709	
alpha	4.2874	4.2969	4.3063	4.3512	4.3598	4.4001	4.4001	4.4076	4.3844	4.3598	4.3425	4.3247	
util living area	0.9964	0.9937	0.9860	0.9593	0.8854	0.7368	0.5786	0.6435	0.8719	0.9756	0.9937	0.9971	(86)
MIT	19.5042	19.6517	19.9319	20.3267	20.6803	20.9045	20.9746	20.9601	20.7831	20.3341	19.8570	19.4830	(87)
Th 2	20.2137	20.2158	20.2179	20.2276	20.2294	20.2379	20.2379	20.2394	20.2346	20.2294	20.2257	20.2219	(88)
util rest of house	0.9956	0.9924	0.9829	0.9496	0.8572	0.6754	0.4896	0.5549	0.8298	0.9682	0.9921	0.9965	(89)
MIT 2	18.1677	18.3845	18.7940	19.3699	19.8625	20.1509	20.2217	20.2120	20.0104	19.3873	18.6918	18.1423	(90)
Living area fraction									fLA = Living area / (4) =			0.2168	(91)
MIT	18.4575	18.6592	19.0407	19.5774	20.0398	20.3143	20.3850	20.3742	20.1780	19.5926	18.9444	18.4330	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4575	18.6592	19.0407	19.5774	20.0398	20.3143	20.3850	20.3742	20.1780	19.5926	18.9444	18.4330	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9932	0.9887	0.9765	0.9394	0.8492	0.6820	0.5075	0.5715	0.8261	0.9600	0.9884	0.9944	(94)
Useful gains	618.2166	684.2383	755.1664	820.5644	805.9711	642.5777	453.9681	467.6686	604.4330	619.5115	591.6138	590.1399	(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	1807.2953	1751.3797	1591.7406	1337.0785	1041.7012	705.2919	467.1646	489.4330	753.6473	1123.2365	1487.0783	1796.5330	(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	884.6746	717.1190	622.4112	371.8901	175.3832	0.0000	0.0000	0.0000	0.0000	374.7714	644.7344	897.5565	(98)
Space heating												4688.5404	(98)
Space heating per m2											(98) / (4) =	31.0685	(99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	4688.5404	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	4922.9675	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2171.7699	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2280.3584	(310a)
Electricity used for heat distribution	72.0333	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	565.4117	(332)
Total delivered energy for all uses	7768.7376	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2401.1086	0.5190	1246.1754	(367)
Electrical energy for heat distribution	72.0333	0.5190	37.3853	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1283.5606	(373)
Space and water heating			1283.5606	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	565.4117	0.5190	293.4487	(379)
Total CO2, kg/year			1577.0093	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4500	(384)

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

DER		10.4500	ZC1
Total Floor Area	TFA	150.9100	
Assumed number of occupants	N	2.9356	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6248	ZC2
CO2 emissions from cooking, equation (L16)		1.2554	ZC3
Total CO2 emissions		24.3302	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		24.3302	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	150.9100 (1b)	x	2.6600 (2b)	=	401.4206	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	401.4206	(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) =	0.0996	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3496	(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) =	0.2972	(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	0.3789	0.3715	0.3641	0.3269	0.3195	0.2823	0.2823	0.2749	0.2972	0.3195	0.3343	0.3492	(22b)
Effective ac	0.5718	0.5690	0.5663	0.5534	0.5510	0.5399	0.5399	0.5378	0.5442	0.5510	0.5559	0.5610	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			17.6000	1.3258	23.3333			(27)
GF			45.0300	0.1300	5.8539			(28a)
Main Type 3	75.7000	17.6000	58.1000	0.1800	10.4580			(29a)
Corridor	6.4900	1.9500	4.5400	0.1800	0.8172			(29a)
Total net area of external elements Aum(A, m2)			127.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.4124			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.3687	(36)
Total fabric heat loss					(33) + (36) =		55.7811	(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	75.7448	75.3755	75.0135	73.3133	72.9952	71.5143	71.5143	71.2401	72.0847	72.9952	73.6387	74.3115	(38)
Heat transfer coeff	131.5259	131.1566	130.7947	129.0944	128.7763	127.2954	127.2954	127.0212	127.8658	128.7763	129.4198	130.0926	(39)
Average = Sum(39)m / 12 =												129.0929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8716	0.8691	0.8667	0.8554	0.8533	0.8435	0.8435	0.8417	0.8473	0.8533	0.8576	0.8621	(40)
HLP (average)												0.8554	(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		2.9356 (42)
Average daily hot water use (litres/day)		103.9205 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3125	110.1557	105.9989	101.8421	97.6853	93.5284	93.5284	97.6853	101.8421	105.9989	110.1557	114.3125	(44)
Energy conte	169.5222	148.2652	152.9964	133.3860	127.9870	110.4431	102.3417	117.4386	118.8412	138.4980	151.1814	164.1732	(45)
Energy content (annual)										Total = Sum(45)m =		1635.0739	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4283	22.2398	22.9495	20.0079	19.1981	16.5665	15.3513	17.6158	17.8262	20.7747	22.6772	24.6260	(46)

Water storage loss:		
Store volume		180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5520 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8381 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (56)
If cylinder contains dedicated solar storage
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (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
218.7649 192.7424 202.2391 181.0402 177.2297 158.0973 151.5844 166.6813 166.4954 187.7406 198.8356 213.4159 (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
218.7649 192.7424 202.2391 181.0402 177.2297 158.0973 151.5844 166.6813 166.4954 187.7406 198.8356 213.4159 (64)
Total per year (kWh/year) = Sum(64)m = 2214.8666 (64)
Heat gains from water heating, kWh/month
95.7603 84.8800 90.2654 82.4742 81.9498 74.8457 73.4228 78.4425 77.6381 85.4447 88.3912 93.9817 (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	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	146.7800	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
32.0160 28.4363 23.1259 17.5078 13.0873 11.0489 11.9387 15.5183 20.8287 26.4468 30.8673 32.9058 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
321.5107 324.8470 316.4397 298.5415 275.9483 254.7139 240.5280 237.1917 245.5990 263.4971 286.0904 307.3248 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 37.6780 (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)
-117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 -117.4240 (71)
Water heating gains (Table 5)
128.7100 126.3095 121.3245 114.5475 110.1476 103.9523 98.6865 105.4334 107.8306 114.8450 122.7655 126.3195 (72)
Total internal gains
552.2707 549.6267 530.9241 500.6308 469.2172 439.7490 421.1871 428.1775 444.2923 474.8230 509.7572 536.5841 (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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)
West	7.2400	19.6403	0.6300	0.7000	0.7700	43.4568	(80)

Solar gains	77.1237	149.3499	249.3286	379.7913	486.7945	509.4041	480.3104	397.0662	294.2742	177.4598	95.7180	63.8032	(83)
Total gains	629.3944	698.9766	780.2527	880.4221	956.0116	949.1531	901.4975	825.2437	738.5665	652.2828	605.4752	600.3872	(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	79.6790	79.9034	80.1245	81.1798	81.3804	82.3271	82.3271	82.5048	81.9598	81.3804	80.9757	80.5569	
alpha	6.3119	6.3269	6.3416	6.4120	6.4254	6.4885	6.4885	6.5003	6.4640	6.4254	6.3984	6.3705	

util living area
0.9997 0.9994 0.9979 0.9888 0.9416 0.7921 0.6103 0.6843 0.9298 0.9949 0.9994 0.9998 (86)

MIT	19.9725	20.0732	20.2664	20.5453	20.8043	20.9586	20.9934	20.9871	20.8712	20.5459	20.2152	19.9588	(87)
Th 2	20.1917	20.1938	20.1959	20.2055	20.2073	20.2158	20.2158	20.2173	20.2125	20.2073	20.2037	20.1999	(88)

util rest of house
0.9996 0.9992 0.9971 0.9841 0.9166 0.7196 0.5074 0.5798 0.8892 0.9922 0.9991 0.9997 (89)

MIT 2	18.7889	18.9378	19.2220	19.6343	19.9961	20.1850	20.2130	20.2111	20.0921	19.6388	19.1534	18.7750	(90)

Living area fraction fLA = Living area / (4) = 0.2168 (91)

MIT	19.0455	19.1840	19.4484	19.8318	20.1713	20.3527	20.3822	20.3794	20.2610	19.8355	19.3836	19.0317	(92)

Temperature adjustment 0.0000
adjusted MIT 19.0455 19.1840 19.4484 19.8318 20.1713 20.3527 20.3822 20.3794 20.2610 19.8355 19.3836 19.0317 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9988	0.9960	0.9812	0.9152	0.7333	0.5298	0.6024	0.8923	0.9904	0.9987	0.9996	(94)
Useful gains	629.0447	698.1197	777.1544	863.8448	874.9803	696.0060	477.5900	497.1624	658.9960	646.0012	604.6956	600.1436	(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
1939.4200 1873.4385 1693.5842 1411.2386 1090.9050 732.2976 481.4568 505.4653 787.7849 1189.3139 1589.7418 1929.4920 (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
974.9193 789.8142 681.8237 394.1235 160.6480 0.0000 0.0000 0.0000 0.0000 404.2246 709.2332 989.0352 (98)
Space heating 5103.8217 (98)
Space heating per m2 (98) / (4) = 33.8203 (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												5458.6328	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	974.9193	789.8142	681.8237	394.1235	160.6480	0.0000	0.0000	0.0000	0.0000	404.2246	709.2332	989.0352	(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)													
	1042.6944	844.7211	729.2232	421.5224	171.8160	0.0000	0.0000	0.0000	0.0000	432.3258	758.5382	1057.7917	(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													
	218.7649	192.7424	202.2391	181.0402	177.2297	158.0973	151.5844	166.6813	166.4954	187.7406	198.8356	213.4159	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3294	88.1806	87.8067	86.8351	84.5531	79.8000	79.8000	79.8000	79.8000	86.8085	87.9187	88.3963	(217)
Fuel for water heating, kWh/month													
	247.6693	218.5769	230.3231	208.4873	209.6074	198.1169	189.9554	208.8738	208.6409	216.2699	226.1584	241.4306	(219)
Water heating fuel used												2604.1099	(219)
Annual totals kWh/year													
Space heating fuel - main system												5458.6328	(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)												565.4117	(232)
Total delivered energy for all uses												8703.1545	(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	5458.6328	0.2160	1179.0647	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2604.1099	0.2160	562.4877	(264)
Space and water heating			1741.5524	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	565.4117	0.5190	293.4487	(268)
Total CO2, kg/m2/year			2073.9261	(272)
Emissions per m2 for space and water heating			11.5403	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.9445	(272b)
Emissions per m2 for pumps and fans			0.2579	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.5403 * 1.55) + 1.9445 + 0.2579, rounded to 2 d.p.			20.0900	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-05	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 5, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	11.23	**TER**	20.80
Environmental	91 B	**% DER<TER**	46.02		
CO_2 Emissions (t/year)	0.98	**DFEE**	32.20	**TFEE**	37.79
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	104.7900 (1b)	x	2.6600 (2b)	=	278.7414	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	278.7414	(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) =	0.1435	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3178	0.3178	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			10.3600	1.3258	13.7348			(27)
Main Type 3	53.2000	10.3600	42.8400	0.1700	7.2828	110.0000	4712.4000	(29a)
Corridor	6.4900	1.9500	4.5400	0.2257	1.0248	110.0000	499.4000	(29a)
Total net area of external elements Aum(A, m2)			59.6900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.3825			(33)
Party Wall 1			54.6700	0.0000	0.0000	20.0000	1093.4000	(32)
Party Floor 1			104.7900			40.0000	4191.6000	(32d)
Party Ceilings 1			104.7900			30.0000	3143.7000	(32b)
Internal Wall 1			205.5500			9.0000	1849.9500	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15490.4500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8237 (35)
Thermal bridges (User defined value 0.100 * total exposed area)		5.9690 (36)
Total fabric heat loss	(33) + (36) =	30.3515 (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	54.3568	54.0320	53.7136	52.2182	51.9385	50.6360	50.6360	50.3948	51.1377	51.9385	52.5045	53.0962	(38)
Heat transfer coeff	84.7083	84.3835	84.0651	82.5697	82.2899	80.9875	80.9875	80.7463	81.4892	82.2899	82.8559	83.4477	(39)
Average = Sum(39)m / 12 =												82.5684	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8084	0.8053	0.8022	0.7880	0.7853	0.7729	0.7729	0.7706	0.7776	0.7853	0.7907	0.7963	(40)
HLP (average)												0.7879	(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		2.7797 (42)
Average daily hot water use (litres/day)		100.2170 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.2387	106.2300	102.2214	98.2127	94.2040	90.1953	90.1953	94.2040	98.2127	102.2214	106.2300	110.2387	(44)
Energy conte	163.4809	142.9814	147.5440	128.6324	123.4259	106.5071	98.6945	113.2534	114.6060	133.5623	145.7937	158.3225	(45)
Energy content (annual)										Total = Sum(45)m =		1576.8041	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5221	21.4472	22.1316	19.2949	18.5139	15.9761	14.8042	16.9880	17.1909	20.0343	21.8690	23.7484	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	23.2624	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.0633	184.1526	193.1264	172.7444	169.0083	150.6191	144.2769	158.8358	158.7180	179.1447	189.9057	203.9049	(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													
	209.0633	184.1526	193.1264	172.7444	169.0083	150.6191	144.2769	158.8358	158.7180	179.1447	189.9057	203.9049	(64)
Total per year (kWh/year) = Sum(64)m =												2113.5001	(64)
Heat gains from water heating, kWh/month													
	90.8233	80.4783	85.5243	78.0599	77.5050	70.7032	69.2819	74.1227	73.3961	80.8754	83.7660	89.1081	(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	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.2268	24.1826	19.6666	14.8889	11.1296	9.3961	10.1528	13.1970	17.7130	22.4907	26.2500	27.9835	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.8470	266.5850	259.6855	244.9974	226.4564	209.0304	197.3887	194.6508	201.5503	216.2384	234.7794	252.2054	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	(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)													
	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	(71)
Water heating gains (Table 5)													
	122.0743	119.7593	114.9520	108.4165	104.1734	98.1989	93.1208	99.6273	101.9390	108.7035	116.3417	119.7690	(72)
Total internal gains													
	477.8431	475.2218	458.9991	432.9978	406.4544	381.3203	365.3573	372.1701	385.8972	412.1275	442.0660	464.6529	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)
Solar gains	33.6669	64.3392	109.3280	175.6089	236.5612	253.2458	236.4373	187.5829	131.4477	76.5874	41.5325	28.0664	(83)
Total gains	511.5100	539.5610	568.3271	608.6066	643.0156	634.5662	601.7946	559.7529	517.3450	488.7149	483.5985	492.7193	(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	50.7967	50.9922	51.1854	52.1124	52.2895	53.1304	53.1304	53.2891	52.8034	52.2895	51.9323	51.5641	
alpha	4.3864	4.3995	4.4124	4.4742	4.4860	4.5420	4.5420	4.5526	4.5202	4.4860	4.4622	4.4376	
util living area													
	0.9926	0.9896	0.9813	0.9544	0.8811	0.7283	0.5685	0.6251	0.8512	0.9636	0.9878	0.9937	(86)
MIT	19.6777	19.7965	20.0341	20.3865	20.7082	20.9172	20.9790	20.9683	20.8206	20.4349	20.0121	19.6651	(87)
Th 2	20.2461	20.2488	20.2514	20.2638	20.2661	20.2769	20.2769	20.2789	20.2728	20.2661	20.2614	20.2565	(88)
util rest of house													
	0.9912	0.9875	0.9774	0.9441	0.8532	0.6690	0.4844	0.5413	0.8072	0.9534	0.9850	0.9925	(89)
MIT 2	18.4442	18.6192	18.9666	19.4824	19.9300	20.2009	20.2634	20.2569	20.0886	19.5577	18.9430	18.4330	(90)
Living area fraction									fLA = Living area / (4) =			0.2427	(91)
MIT	18.7435	18.9049	19.2256	19.7018	20.1189	20.3748	20.4370	20.4295	20.2663	19.7705	19.2024	18.7320	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7435	18.9049	19.2256	19.7018	20.1189	20.3748	20.4370	20.4295	20.2663	19.7705	19.2024	18.7320	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9872	0.9825	0.9703	0.9345	0.8468	0.6776	0.5036	0.5596	0.8067	0.9447	0.9796	0.9890	(94)
Useful gains	504.9583	530.1091	551.4278	568.7179	544.5193	429.9756	303.0869	313.2471	417.3498	461.6964	473.7462	487.3031	(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													
	1223.4868	1181.7843	1069.7813	891.8993	692.7884	467.6830	310.7515	325.3672	502.4840	754.6439	1002.7597	1212.6601	(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													
	534.5852	437.9257	385.6550	232.6906	110.3122	0.0000	0.0000	0.0000	0.0000	217.9529	380.8897	539.6656	(98)
Space heating												2839.6769	(98)
Space heating per m2											(98) / (4) =	27.0987	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	2839.6769	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	2981.6608	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2113.5001	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2219.1751	(310a)
Electricity used for heat distribution	52.0084	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	480.8332	(332)
Total delivered energy for all uses	5681.6690	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	1733.6119	0.5190	899.7446	(367)
Electrical energy for heat distribution	52.0084	0.5190	26.9923	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			926.7369	(373)
Space and water heating			926.7369	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	480.8332	0.5190	249.5524	(379)
Total CO2, kg/year			1176.2893	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2300	(384)

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

DER		11.2300	ZC1
Total Floor Area	TFA	104.7900	
Assumed number of occupants	N	2.7797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.9203	ZC2
CO2 emissions from cooking, equation (L16)		1.7722	ZC3
Total CO2 emissions		27.9226	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		27.9226	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	104.7900 (1b)	x	2.6600 (2b)	=	278.7414	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	278.7414	(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) =	0.1435	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3178	0.3178	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			10.3600	1.3258	13.7348			(27)
Main Type 3	53.2000	10.3600	42.8400	0.1800	7.7112			(29a)
Corridor	6.4900	1.9500	4.5400	0.1800	0.8172			(29a)
Total net area of external elements Aum(A, m2)			59.6900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.2132			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7469	(36)
Total fabric heat loss					(33) + (36) =		29.9601	(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	54.3568	54.0320	53.7136	52.2182	51.9385	50.6360	50.6360	50.3948	51.1377	51.9385	52.5045	53.0962	(38)
Heat transfer coeff	84.3169	83.9921	83.6738	82.1784	81.8986	80.5962	80.5962	80.3550	81.0979	81.8986	82.4646	83.0563	(39)
Average = Sum(39)m / 12 =												82.1771	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8046	0.8015	0.7985	0.7842	0.7815	0.7691	0.7691	0.7668	0.7739	0.7815	0.7870	0.7926	(40)
HLP (average)												0.7842	(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	2.7797	(42)
Average daily hot water use (litres/day)	100.2170	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.2387	106.2300	102.2214	98.2127	94.2040	90.1953	90.1953	94.2040	98.2127	102.2214	106.2300	110.2387	(44)
Energy conte	163.4809	142.9814	147.5440	128.6324	123.4259	106.5071	98.6945	113.2534	114.6060	133.5623	145.7937	158.3225	(45)
Energy content (annual)										Total = Sum(45)m =		1576.8041	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5221	21.4472	22.1316	19.2949	18.5139	15.9761	14.8042	16.9880	17.1909	20.0343	21.8690	23.7484	(46)

Water storage loss:		
Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8381	(55)
Total storage loss		

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	212.7235	187.4586	196.7867	176.2866	172.6685	154.1613	147.9372	162.4961	162.2602	182.8049	193.4479	207.5651	(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													
	212.7235	187.4586	196.7867	176.2866	172.6685	154.1613	147.9372	162.4961	162.2602	182.8049	193.4479	207.5651	(64)
								Total per year (kWh/year) = Sum(64)m =				2156.5968	(64)
Heat gains from water heating, kWh/month													
	93.7515	83.1231	88.4525	80.8936	80.4332	73.5370	72.2101	77.0509	76.2299	83.8036	86.5997	92.0364	(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	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	138.9832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.2268	24.1826	19.6666	14.8889	11.1296	9.3961	10.1528	13.1970	17.7130	22.4907	26.2500	27.9835	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.8470	266.5850	259.6855	244.9974	226.4564	209.0304	197.3887	194.6508	201.5503	216.2384	234.7794	252.2054	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	36.8983	(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)													
	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	-111.1866	(71)
Water heating gains (Table 5)													
	126.0101	123.6951	118.8878	112.3523	108.1092	102.1347	97.0565	103.5630	105.8748	112.6392	120.2774	123.7048	(72)
Total internal gains													
	484.7789	482.1576	465.9349	439.9335	413.3901	388.2561	372.2930	379.1058	392.8330	419.0632	449.0018	471.5886	(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	10.3600	10.6334	0.6300	0.7000	0.7700	33.6669	(74)

Solar gains	33.6669	64.3392	109.3280	175.6089	236.5612	253.2458	236.4373	187.5829	131.4477	76.5874	41.5325	28.0664	(83)
Total gains	518.4458	546.4968	575.2629	615.5424	649.9514	641.5019	608.7304	566.6887	524.2808	495.6507	490.5343	499.6550	(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	86.3063	86.6401	86.9697	88.5523	88.8548	90.2907	90.2907	90.5617	89.7321	88.8548	88.2449	87.6162	
alpha	6.7538	6.7760	6.7980	6.9035	6.9237	7.0194	7.0194	7.0374	6.9821	6.9237	6.8830	6.8411	
util living area													
	0.9993	0.9987	0.9967	0.9858	0.9316	0.7628	0.5770	0.6407	0.9013	0.9900	0.9983	0.9994	(86)
MIT	20.1488	20.2282	20.3873	20.6279	20.8500	20.9745	20.9967	20.9937	20.9163	20.6531	20.3699	20.1411	(87)
Th 2	20.2493	20.2520	20.2546	20.2670	20.2694	20.2802	20.2802	20.2822	20.2760	20.2694	20.2647	20.2598	(88)
util rest of house													
	0.9990	0.9983	0.9955	0.9801	0.9047	0.6931	0.4856	0.5467	0.8538	0.9850	0.9977	0.9992	(89)
MIT 2	19.0911	19.2094	19.4437	19.8018	20.1092	20.2616	20.2788	20.2792	20.2010	19.8421	19.4266	19.0879	(90)
Living area fraction										fLA = Living area / (4) =		0.2427	(91)
MIT	19.3478	19.4566	19.6727	20.0022	20.2890	20.4346	20.4530	20.4526	20.3746	20.0389	19.6555	19.3435	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3478	19.4566	19.6727	20.0022	20.2890	20.4346	20.4530	20.4526	20.3746	20.0389	19.6555	19.3435	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9976	0.9942	0.9775	0.9055	0.7089	0.5079	0.5696	0.8613	0.9830	0.9969	0.9989	(94)
Useful gains	517.7181	545.2041	571.9334	601.6902	588.5584	454.7730	309.1826	322.8047	451.5518	487.2044	489.0208	499.1101	(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													
	1268.7805	1222.6408	1102.2078	912.3644	703.4261	470.2479	310.5388	325.6451	508.8564	773.0322	1035.3864	1257.7646	(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													
	558.7904	455.2375	394.5242	223.6854	85.4615	0.0000	0.0000	0.0000	0.0000	212.6559	393.3832	564.4389	(98)
Space heating												2888.1770	(98)
Space heating per m2											(98) / (4) =	27.5616	(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												3088.9594	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	558.7904	455.2375	394.5242	223.6854	85.4615	0.0000	0.0000	0.0000	0.0000	212.6559	393.3832	564.4389	(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)													
	597.6367	486.8850	421.9510	239.2357	91.4027	0.0000	0.0000	0.0000	0.0000	227.4395	420.7307	603.6780	(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													
	212.7235	187.4586	196.7867	176.2866	172.6685	154.1613	147.9372	162.4961	162.2602	182.8049	193.4479	207.5651	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2735	87.0938	86.6341	85.4501	83.0510	79.8000	79.8000	79.8000	79.8000	85.2180	86.6691	87.3509	(217)
Fuel for water heating, kWh/month													
	243.7436	215.2376	227.1469	206.3036	207.9067	193.1846	185.3850	203.6292	203.3336	214.5144	223.2027	237.6222	(219)
Water heating fuel used												2561.2101	(219)
Annual totals kWh/year													
Space heating fuel - main system												3088.9594	(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)												480.8332	(232)
Total delivered energy for all uses												6206.0026	(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	3088.9594	0.2160	667.2152	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2561.2101	0.2160	553.2214	(264)
Space and water heating			1220.4366	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	480.8332	0.5190	249.5524	(268)
Total CO2, kg/m2/year			1508.9140	(272)
Emissions per m2 for space and water heating			11.6465	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3815	(272b)
Emissions per m2 for pumps and fans			0.3715	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.6465 * 1.55) + 2.3815 + 0.3715, rounded to 2 d.p.			20.8000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-06	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 6, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	11.42	**TER**	21.38
Environmental	90 B	**% DER<TER**	46.59		
CO_2 Emissions (t/year)	1.10	**DFEE**	36.62	**TFEE**	42.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.72		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	114.8400 (1b)	x	2.6600 (2b)	=	305.4744	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.4744	(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) =	0.1309	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3809	(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) =	0.3238	(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	0.4128	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5663	0.5724	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			18.1000	1.3258	23.9962			(27)
Main Type 3	70.9700	18.1000	52.8700	0.1700	8.9879	110.0000	5815.7000	(29a)
Corridor	4.5200	1.9500	2.5700	0.2257	0.5801	110.0000	282.7000	(29a)
Total net area of external elements Aum(A, m2)			75.4900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.9042			(33)
Party Wall 1			56.0700	0.0000	0.0000	20.0000	1121.4000	(32)
Party Floor 1			114.8400			40.0000	4593.6000	(32d)
Party Ceilings 1			114.8400			30.0000	3445.2000	(32b)
Internal Wall 1			242.3800			9.0000	2181.4200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17440.0200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		151.8636 (35)
Thermal bridges (User defined value 0.114 * total exposed area)		8.6059 (36)
Total fabric heat loss	(33) + (36) =	44.5101 (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	58.9942	58.6606	58.3336	56.7977	56.5104	55.1727	55.1727	54.9250	55.6880	56.5104	57.0917	57.6994	(38)
Heat transfer coeff	103.5043	103.1707	102.8437	101.3078	101.0205	99.6828	99.6828	99.4351	100.1981	101.0205	101.6018	102.2095	(39)
Average = Sum(39)m / 12 =												101.3065	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9013	0.8984	0.8955	0.8822	0.8797	0.8680	0.8680	0.8659	0.8725	0.8797	0.8847	0.8900	(40)
HLP (average)												0.8822	(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	2.8410 (42)
Average daily hot water use (litres/day)	101.6729 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8402	107.7733	103.7064	99.6395	95.5725	91.5056	91.5056	95.5725	99.6395	103.7064	107.7733	111.8402	(44)
Energy conte	165.8558	145.0585	149.6874	130.5011	125.2189	108.0544	100.1283	114.8987	116.2709	135.5026	147.9117	160.6225	(45)
Energy content (annual)										Total = Sum(45)m =		1599.7109	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8784	21.7588	22.4531	19.5752	18.7828	16.2082	15.0192	17.2348	17.4406	20.3254	22.1867	24.0934	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	211.4382	186.2297	195.2698	174.6131	170.8013	152.1664	145.7107	160.4811	160.3829	181.0850	192.0237	206.2049	(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													
	211.4382	186.2297	195.2698	174.6131	170.8013	152.1664	145.7107	160.4811	160.3829	181.0850	192.0237	206.2049	(64)
Total per year (kWh/year) = Sum(64)m =												2136.4069	(64)
Heat gains from water heating, kWh/month													
	91.6130	81.1689	86.2370	78.6812	78.1012	71.2177	69.7586	74.6697	73.9497	81.5205	84.4702	89.8729	(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	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9653	23.0621	18.7554	14.1990	10.6139	8.9607	9.6824	12.5855	16.8923	21.4487	25.0337	26.6869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	278.3346	281.2229	273.9446	258.4500	238.8908	220.5080	208.2272	205.3389	212.6172	228.1118	247.6709	266.0538	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	(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)													
	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	(71)
Water heating gains (Table 5)													
	123.1357	120.7871	115.9099	109.2795	104.9748	98.9135	93.7615	100.3625	102.7079	109.5706	117.3198	120.7969	(72)
Total internal gains													
	493.0501	490.6866	474.2244	447.5430	420.0940	393.9967	377.2856	383.9015	397.8319	424.7455	455.6389	479.1521	(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	15.8900	10.6334	0.6300	0.7000	0.7700	51.6378	(74)
East	2.2100	19.6403	0.6300	0.7000	0.7700	13.2651	(76)
Solar gains	64.9029	124.6318	210.4205	331.6724	439.2171	466.6163	437.0857	351.6560	251.3149	148.2597	80.2419	53.9564	(83)
Total gains	557.9530	615.3184	684.6449	779.2154	859.3112	860.6130	814.3712	735.5575	649.1468	573.0052	535.8808	533.1085	(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	46.8043	46.9557	47.1050	47.8191	47.9551	48.5987	48.5987	48.7197	48.3487	47.9551	47.6807	47.3972	
alpha	4.1203	4.1304	4.1403	4.1879	4.1970	4.2399	4.2399	4.2480	4.2232	4.1970	4.1787	4.1598	
util living area													
	0.9936	0.9895	0.9781	0.9396	0.8418	0.6732	0.5198	0.5878	0.8331	0.9627	0.9891	0.9947	(86)
MIT	19.5098	19.6636	19.9556	20.3701	20.7240	20.9249	20.9804	20.9679	20.8074	20.3628	19.8751	19.4889	(87)
Th 2	20.1664	20.1689	20.1713	20.1827	20.1848	20.1948	20.1948	20.1966	20.1909	20.1848	20.1805	20.1760	(88)
util rest of house													
	0.9922	0.9873	0.9733	0.9259	0.8066	0.6076	0.4323	0.4981	0.7828	0.9517	0.9865	0.9936	(89)
MIT 2	18.1429	18.3685	18.7941	19.3948	19.8780	20.1295	20.1830	20.1757	19.9995	19.3938	18.6857	18.1188	(90)
Living area fraction									fLA = Living area / (4) =			0.3265	(91)
MIT	18.5891	18.7913	19.1733	19.7132	20.1542	20.3892	20.4433	20.4343	20.2632	19.7102	19.0740	18.5661	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5891	18.7913	19.1733	19.7132	20.1542	20.3892	20.4433	20.4343	20.2632	19.7102	19.0740	18.5661	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9887	0.9824	0.9657	0.9164	0.8051	0.6243	0.4601	0.5257	0.7878	0.9435	0.9815	0.9905	(94)
Useful gains	551.6510	604.4911	661.1802	714.0725	691.8243	537.2536	374.6594	386.6688	511.4302	540.6475	525.9903	528.0634	(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													
	1478.9845	1433.1715	1303.3686	1095.4607	854.0459	577.0820	383.1148	401.1515	617.5450	920.3122	1216.5810	1468.3476	(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													
	689.9361	556.8732	477.7882	274.5995	120.6928	0.0000	0.0000	0.0000	0.0000	282.4705	497.2253	699.5715	(98)
Space heating												3599.1572	(98)
Space heating per m2											(98) / (4) =	31.3406	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	3599.1572	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	3779.1150	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2136.4069	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2243.2273	(310a)
Electricity used for heat distribution	60.2234	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	458.5552	(332)
Total delivered energy for all uses	6480.8975	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2007.4474	0.5190	1041.8652	(367)
Electrical energy for heat distribution	60.2234	0.5190	31.2560	(372)
Total CO2 associated with community systems			1073.1212	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1073.1212	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	458.5552	0.5190	237.9901	(379)
Total CO2, kg/year			1311.1113	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4200	(384)

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

DER		11.4200	ZC1
Total Floor Area	TFA	114.8400	
Assumed number of occupants	N	2.8410	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3622	ZC2
CO2 emissions from cooking, equation (L16)		1.6299	ZC3
Total CO2 emissions		27.4121	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		27.4121	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	114.8400 (1b)	x	2.6600 (2b)	=	305.4744	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.4744	(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) =	0.1309	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3809	(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) =	0.3238	(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	0.4128	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5663	0.5724	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			18.1000	1.3258	23.9962			(27)
Main Type 3	70.9700	18.1000	52.8700	0.1800	9.5166			(29a)
Corridor	4.5200	1.9500	2.5700	0.1800	0.4626			(29a)
Total net area of external elements Aum(A, m2)			75.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.9254			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1617	(36)
Total fabric heat loss					(33) + (36) =		44.0871	(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	58.9942	58.6606	58.3336	56.7977	56.5104	55.1727	55.1727	54.9250	55.6880	56.5104	57.0917	57.6994	(38)
Heat transfer coeff	103.0813	102.7477	102.4207	100.8848	100.5975	99.2598	99.2598	99.0121	99.7751	100.5975	101.1788	101.7865	(39)
Average = Sum(39)m / 12 =												100.8835	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8976	0.8947	0.8919	0.8785	0.8760	0.8643	0.8643	0.8622	0.8688	0.8760	0.8810	0.8863	(40)
HLP (average)												0.8785	(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		2.8410 (42)
Average daily hot water use (litres/day)		101.6729 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8402	107.7733	103.7064	99.6395	95.5725	91.5056	91.5056	95.5725	99.6395	103.7064	107.7733	111.8402	(44)
Energy conte	165.8558	145.0585	149.6874	130.5011	125.2189	108.0544	100.1283	114.8987	116.2709	135.5026	147.9117	160.6225	(45)
Energy content (annual)										Total = Sum(45)m =		1599.7109	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8784	21.7588	22.4531	19.5752	18.7828	16.2082	15.0192	17.2348	17.4406	20.3254	22.1867	24.0934	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	215.0985	189.5358	198.9301	178.1553	174.4616	155.7086	149.3710	164.1414	163.9251	184.7453	195.5659	209.8652	(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													
	215.0985	189.5358	198.9301	178.1553	174.4616	155.7086	149.3710	164.1414	163.9251	184.7453	195.5659	209.8652	(64)
								Total per year (kWh/year) = Sum(64)m =				2179.5037	(64)
Heat gains from water heating, kWh/month													
	94.5412	83.8138	89.1652	81.5150	81.0294	74.0515	72.6868	77.5980	76.7834	84.4487	87.3040	92.8011	(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	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	142.0483	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9653	23.0621	18.7554	14.1990	10.6139	8.9607	9.6824	12.5855	16.8923	21.4487	25.0337	26.6869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	278.3346	281.2229	273.9446	258.4500	238.8908	220.5080	208.2272	205.3389	212.6172	228.1118	247.6709	266.0538	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	37.2048	(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)													
	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	-113.6386	(71)
Water heating gains (Table 5)													
	127.0715	124.7229	119.8457	113.2153	108.9105	102.8492	97.6973	104.2983	106.6437	113.5064	121.2555	124.7327	(72)
Total internal gains													
	499.9859	497.6223	481.1602	454.4788	427.0298	400.9325	384.2213	390.8373	404.7676	431.6813	462.5747	486.0879	(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	15.8900	10.6334	0.6300	0.7000	0.7700	51.6378	(74)
East	2.2100	19.6403	0.6300	0.7000	0.7700	13.2651	(76)

Solar gains	64.9029	124.6318	210.4205	331.6724	439.2171	466.6163	437.0857	351.6560	251.3149	148.2597	80.2419	53.9564	(83)
Total gains	564.8888	622.2542	691.5807	786.1512	866.2469	867.5487	821.3070	742.4933	656.0826	579.9410	542.8166	540.0443	(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	77.3661	77.6173	77.8651	79.0505	79.2763	80.3447	80.3447	80.5457	79.9298	79.2763	78.8209	78.3502	
alpha	6.1577	6.1745	6.1910	6.2700	6.2851	6.3563	6.3563	6.3697	6.3287	6.2851	6.2547	6.2233	
util living area													
	0.9993	0.9985	0.9953	0.9765	0.8936	0.7022	0.5272	0.6026	0.8834	0.9889	0.9984	0.9995	(86)
MIT	20.0082	20.1141	20.3162	20.6102	20.8610	20.9775	20.9968	20.9931	20.9062	20.5931	20.2567	19.9947	(87)
Th 2	20.1695	20.1720	20.1744	20.1858	20.1880	20.1979	20.1979	20.1998	20.1941	20.1880	20.1836	20.1791	(88)
util rest of house													
	0.9991	0.9980	0.9935	0.9674	0.8564	0.6264	0.4336	0.5034	0.8286	0.9833	0.9978	0.9993	(89)
MIT 2	18.8243	18.9809	19.2777	19.7095	20.0468	20.1825	20.1966	20.1967	20.1128	19.6909	19.1985	18.8117	(90)
Living area fraction										fLA = Living area / (4) =		0.3265	(91)
MIT	19.2108	19.3509	19.6168	20.0035	20.3126	20.4420	20.4579	20.4566	20.3718	19.9854	19.5439	19.1979	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2108	19.3509	19.6168	20.0035	20.3126	20.4420	20.4579	20.4566	20.3718	19.9854	19.5439	19.1979	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9973	0.9920	0.9649	0.8628	0.6504	0.4643	0.5359	0.8423	0.9814	0.9970	0.9990	(94)
Useful gains	564.1363	620.5683	686.0326	758.5955	747.4087	564.2137	381.3239	397.9354	552.6130	569.1749	541.2126	539.5016	(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													
	1537.0228	1484.7925	1343.4276	1120.1795	866.4060	579.8767	382.9295	401.6572	625.7684	944.1512	1259.0623	1526.5847	(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													
	723.8275	580.7587	489.1019	260.3405	88.5340	0.0000	0.0000	0.0000	0.0000	278.9824	516.8518	734.3898	(98)
Space heating												3672.7866	(98)
Space heating per m2											(98) / (4) =	31.9818	(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												3928.1140	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	723.8275	580.7587	489.1019	260.3405	88.5340	0.0000	0.0000	0.0000	0.0000	278.9824	516.8518	734.3898	(98)
Space heating efficiency (main heating system 1)													
	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)													
	774.1471	621.1323	523.1036	278.4391	94.6888	0.0000	0.0000	0.0000	0.0000	298.3769	552.7827	785.4437	(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													
	215.0985	189.5358	198.9301	178.1553	174.4616	155.7086	149.3710	164.1414	163.9251	184.7453	195.5659	209.8652	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.8029	87.6095	87.1224	85.8245	83.1078	79.8000	79.8000	79.8000	79.8000	85.9108	87.2872	87.8811	(217)
Fuel for water heating, kWh/month													
	244.9788	216.3415	228.3339	207.5809	209.9221	195.1236	187.1817	205.6909	205.4200	215.0432	224.0488	238.8059	(219)
Water heating fuel used												2578.4712	(219)
Annual totals kWh/year													
Space heating fuel - main system												3928.1140	(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)												458.5552	(232)
Total delivered energy for all uses												7040.1405	(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	3928.1140	0.2160	848.4726	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.4712	0.2160	556.9498	(264)
Space and water heating			1405.4224	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	458.5552	0.5190	237.9901	(268)
Total CO2, kg/m2/year			1682.3376	(272)
Emissions per m2 for space and water heating			12.2381	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0724	(272b)
Emissions per m2 for pumps and fans			0.3389	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.2381 * 1.55) + 2.0724 + 0.3389, rounded to 2 d.p.			21.3800	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-07	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT GF
Property	Plot 7, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	11.87	**TER**	21.52
Environmental	90 B	**% DER<TER**	44.85		
CO_2 Emissions (t/year)	1.17	**DFEE**	38.40	**TFEE**	43.82
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.35		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	120.9900 (1b)	x	2.6600 (2b)	=	321.8334	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	120.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	321.8334	(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) =	0.1243	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3743	(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) =	0.3181	(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	0.4056	0.3977	0.3897	0.3500	0.3420	0.3022	0.3022	0.2943	0.3181	0.3420	0.3579	0.3738	(22b)
Effective ac	0.5823	0.5791	0.5759	0.5612	0.5585	0.5457	0.5457	0.5433	0.5506	0.5585	0.5641	0.5699	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			12.1600	1.3258	16.1212			(27)
GF			76.7200	0.1200	9.2064	75.0000	5754.0000	(28a)
Main Type 3	66.2200	12.1600	54.0600	0.1700	9.1902	110.0000	5946.6000	(29a)
Corridor	24.4600	1.9500	22.5100	0.2257	5.0813	110.0000	2476.1000	(29a)
Total net area of external elements Aum(A, m2)			167.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9391			(33)
Party Wall 1			38.4000	0.0000	0.0000	20.0000	768.0000	(32)
Party Floor 1			44.2700			40.0000	1770.8000	(32d)
Party Ceilings 1			120.9900			30.0000	3629.7000	(32b)
Internal Wall 1			223.5500			75.0000	16766.2500	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	37111.4500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		306.7315 (35)
Thermal bridges (User defined value 0.073 * total exposed area)		12.2202 (36)
Total fabric heat loss	(33) + (36) =	54.1593 (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	61.8400	61.5007	61.1681	59.6061	59.3138	57.9533	57.9533	57.7013	58.4773	59.3138	59.9050	60.5231	(38)
Heat transfer coeff	115.9992	115.6600	115.3274	113.7653	113.4731	112.1126	112.1126	111.8606	112.6366	113.4731	114.0643	114.6824	(39)
Average = Sum(39)m / 12 =												113.7639	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9588	0.9559	0.9532	0.9403	0.9379	0.9266	0.9266	0.9245	0.9310	0.9379	0.9428	0.9479	(40)
HLP (average)												0.9403	(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	2.8671 (42)
Average daily hot water use (litres/day)	102.2927 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5219	108.4302	104.3385	100.2468	96.1551	92.0634	92.0634	96.1551	100.2468	104.3385	108.4302	112.5219	(44)
Energy conte	166.8668	145.9427	150.5998	131.2966	125.9822	108.7131	100.7386	115.5991	116.9797	136.3285	148.8133	161.6016	(45)
Energy content (annual)										Total = Sum(45)m =		1609.4619	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0300	21.8914	22.5900	19.6945	18.8973	16.3070	15.1108	17.3399	17.5470	20.4493	22.3220	24.2402	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 0.7200 (55)
Total storage loss

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)

If cylinder contains dedicated solar storage

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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

	212.4492	187.1139	196.1822	175.4086	171.5646	152.8251	146.3210	161.1815	161.0917	181.9109	192.9253	207.1840 (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

	212.4492	187.1139	196.1822	175.4086	171.5646	152.8251	146.3210	161.1815	161.0917	181.9109	192.9253	207.1840 (64)

Total per year (kWh/year) = Sum(64)m = 2146.1579 (64)

Heat gains from water heating, kWh/month

	91.9491	81.4629	86.5404	78.9457	78.3550	71.4367	69.9615	74.9026	74.1853	81.7952	84.7700	90.1984 (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	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	(66)

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

	29.4620	26.1679	21.2812	16.1112	12.0433	10.1675	10.9863	14.2804	19.1672	24.3371	28.4050	30.2809 (67)

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

	286.4964	289.4694	281.9777	266.0287	245.8960	226.9742	214.3332	211.3602	218.8519	234.8009	254.9336	273.8555 (68)

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

	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353	37.3353 (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)

	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824	-114.6824 (71)

Water heating gains (Table 5)

	123.5875	121.2246	116.3177	109.6468	105.3159	99.2176	94.0343	100.6755	103.0352	109.9397	117.7361	121.2345 (72)

Total internal gains

	505.5519	502.8678	485.5825	457.7927	429.2611	402.3652	385.3597	392.3221	407.0602	435.0837	467.0806	491.3767 (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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	7.7400	46.7521	0.6300	0.7000	0.7700	110.5894	(78)

Solar gains	137.1197	233.0158	316.1808	385.4062	424.4879	417.8786	404.3800	376.0112	340.4098	256.9340	164.1663	117.3766 (83)
Total gains	642.6716	735.8836	801.7633	843.1989	853.7490	820.2437	789.7397	768.3333	747.4701	692.0176	631.2469	608.7533 (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	88.8690	89.1297	89.3867	90.6140	90.8474	91.9499	91.9499	92.1570	91.5221	90.8474	90.3765	89.8894	
alpha	6.9246	6.9420	6.9591	7.0409	7.0565	7.1300	7.1300	7.1438	7.1015	7.0565	7.0251	6.9926	
util living area	0.9997	0.9990	0.9969	0.9875	0.9477	0.8111	0.6163	0.6566	0.8930	0.9903	0.9991	0.9998	(86)
MIT	20.1219	20.2354	20.4074	20.6300	20.8325	20.9644	20.9955	20.9931	20.9253	20.6633	20.3508	20.1046	(87)
Th 2	20.1178	20.1202	20.1225	20.1334	20.1354	20.1449	20.1449	20.1467	20.1413	20.1354	20.1313	20.1270	(88)
util rest of house	0.9995	0.9986	0.9954	0.9811	0.9199	0.7295	0.5014	0.5422	0.8317	0.9842	0.9986	0.9997	(89)
MIT 2	18.9333	19.1011	19.3541	19.6844	19.9642	20.1217	20.1434	20.1442	20.0826	19.7358	19.2788	18.9151	(90)
Living area fraction									fLA = Living area / (4) =			0.2324	(91)
MIT	19.2096	19.3647	19.5989	19.9042	20.1660	20.3175	20.3415	20.3415	20.2785	19.9514	19.5280	19.1915	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2096	19.3647	19.5989	19.9042	20.1660	20.3175	20.3415	20.3415	20.2785	19.9514	19.5280	19.1915	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9981	0.9943	0.9789	0.9211	0.7475	0.5284	0.5692	0.8431	0.9824	0.9981	0.9995	(94)
Useful gains	642.2457	734.5043	797.1535	825.4259	786.3865	613.1003	417.2937	437.3029	630.1787	679.8403	630.0539	608.4768	(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	1729.5016	1672.9912	1510.6601	1251.8942	960.6621	641.0073	419.4666	440.8960	695.9218	1061.1320	1417.5868	1719.2648	(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	808.9184	630.6632	530.8489	307.0572	129.6610	0.0000	0.0000	0.0000	0.0000	283.6810	567.0237	826.4263	(98)
Space heating												4084.2796	(98)
Space heating per m2											(98) / (4) =	33.7572	(99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	4084.2796	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	4288.4936	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2146.1579	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2253.4658	(310a)
Electricity used for heat distribution	65.4196	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	520.3087	(332)
Total delivered energy for all uses	7062.2682	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2180.6532	0.5190	1131.7590	(367)
Electrical energy for heat distribution	65.4196	0.5190	33.9528	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1165.7118	(373)
Space and water heating			1165.7118	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	520.3087	0.5190	270.0402	(379)
Total CO2, kg/year			1435.7520	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			11.8700	(384)

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

DER		11.8700	ZC1
Total Floor Area	TFA	120.9900	
Assumed number of occupants	N	2.8671	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.0319	ZC2
CO2 emissions from cooking, equation (L16)		1.5523	ZC3
Total CO2 emissions		27.4542	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		27.4542	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	120.9900 (1b)	x	2.6600 (2b)	=	321.8334	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	120.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	321.8334	(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) =	0.1243	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3743	(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) =		0.3181	(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	0.4056	0.3977	0.3897	0.3500	0.3420	0.3022	0.3022	0.2943	0.3181	0.3420	0.3579	0.3738	(22b)
Effective ac	0.5823	0.5791	0.5759	0.5612	0.5585	0.5457	0.5457	0.5433	0.5506	0.5585	0.5641	0.5699	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			12.1600	1.3258	16.1212			(27)
GF			76.7200	0.1300	9.9736			(28a)
Main Type 3	66.2200	12.1600	54.0600	0.1800	9.7308			(29a)
Corridor	24.4600	1.9500	22.5100	0.1800	4.0518			(29a)
Total net area of external elements Aum(A, m2)			167.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.8274			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.2652	(36)
Total fabric heat loss (33) + (36) =	54.0926	(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	61.8400	61.5007	61.1681	59.6061	59.3138	57.9533	57.9533	57.7013	58.4773	59.3138	59.9050	60.5231	(38)
Heat transfer coeff	115.9326	115.5933	115.2607	113.6987	113.4064	112.0459	112.0459	111.7940	112.5700	113.4064	113.9976	114.6157	(39)
Average = Sum(39)m / 12 =												113.6973	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9582	0.9554	0.9526	0.9397	0.9373	0.9261	0.9261	0.9240	0.9304	0.9373	0.9422	0.9473	(40)
HLP (average)												0.9397	(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	2.8671 (42)
Average daily hot water use (litres/day)	102.2927 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5219	108.4302	104.3385	100.2468	96.1551	92.0634	92.0634	96.1551	100.2468	104.3385	108.4302	112.5219	(44)
Energy conte	166.8668	145.9427	150.5998	131.2966	125.9822	108.7131	100.7386	115.5991	116.9797	136.3285	148.8133	161.6016	(45)
Energy content (annual)										Total = Sum(45)m =		1609.4619	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0300	21.8914	22.5900	19.6945	18.8973	16.3070	15.1108	17.3399	17.5470	20.4493	22.3220	24.2402	(46)

Water storage loss:	
Store volume	180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8381 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (56)
If cylinder contains dedicated solar storage
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (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
216.1094 190.4200 199.8425 178.9508 175.2249 156.3673 149.9813 164.8417 164.6339 185.5712 196.4675 210.8442 (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
216.1094 190.4200 199.8425 178.9508 175.2249 156.3673 149.9813 164.8417 164.6339 185.5712 196.4675 210.8442 (64)
Total per year (kWh/year) = Sum(64)m = 2189.2547 (64)
Heat gains from water heating, kWh/month
94.8773 84.1078 89.4686 81.7795 81.2832 74.2705 72.8897 77.8308 77.0191 84.7234 87.6038 93.1267 (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	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	143.3530	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
29.4620 26.1679 21.2812 16.1112 12.0433 10.1675 10.9863 14.2804 19.1672 24.3371 28.4050 30.2809 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
286.4964 289.4694 281.9777 266.0287 245.8960 226.9742 214.3332 211.3602 218.8519 234.8009 254.9336 273.8555 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 37.3353 (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)
-114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 -114.6824 (71)
Water heating gains (Table 5)
127.5233 125.1604 120.2535 113.5826 109.2516 103.1534 97.9701 104.6113 106.9710 113.8755 121.6719 125.1702 (72)
Total internal gains
512.4877 509.8036 492.5182 464.7284 436.1969 409.3009 392.2955 399.2579 413.9960 442.0194 474.0164 498.3125 (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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	7.7400	46.7521	0.6300	0.7000	0.7700	110.5894	(78)

Solar gains	137.1197	233.0158	316.1808	385.4062	424.4879	417.8786	404.3800	376.0112	340.4098	256.9340	164.1663	117.3766	(83)
Total gains	649.6074	742.8193	808.6991	850.1347	860.6848	827.1795	796.6755	775.2691	754.4058	698.9534	638.1827	615.6891	(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	72.4739	72.6866	72.8963	73.8978	74.0883	74.9879	74.9879	75.1569	74.6388	74.0883	73.7040	73.3065	
alpha	5.8316	5.8458	5.8598	5.9265	5.9392	5.9992	5.9992	6.0105	5.9759	5.9392	5.9136	5.8871	
util living area	0.9989	0.9972	0.9926	0.9771	0.9272	0.7894	0.6051	0.6433	0.8688	0.9813	0.9972	0.9992	(86)
MIT	19.9647	20.0984	20.3007	20.5601	20.7928	20.9481	20.9911	20.9874	20.9019	20.6015	20.2351	19.9439	(87)
Th 2	20.1183	20.1207	20.1230	20.1339	20.1359	20.1454	20.1454	20.1472	20.1417	20.1359	20.1318	20.1275	(88)
util rest of house	0.9985	0.9963	0.9900	0.9681	0.8970	0.7123	0.4948	0.5341	0.8087	0.9722	0.9961	0.9989	(89)
MIT 2	18.7220	18.9192	19.2154	19.5969	19.9175	20.1073	20.1417	20.1414	20.0588	19.6605	19.1275	18.6985	(90)
Living area fraction									fLA = Living area / (4) =			0.2324	(91)
MIT	19.0108	19.1932	19.4676	19.8207	20.1209	20.3027	20.3392	20.3380	20.2548	19.8792	19.3849	18.9879	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0108	19.1932	19.4676	19.8207	20.1209	20.3027	20.3392	20.3380	20.2548	19.8792	19.3849	18.9879	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9873	0.9640	0.8964	0.7278	0.5205	0.5595	0.8178	0.9686	0.9948	0.9984	(94)
Useful gains	648.1604	738.9835	798.3976	819.5207	771.5061	602.0059	414.7058	433.7856	616.9256	677.0108	634.8389	614.6783	(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	1705.4657	1652.2021	1494.6570	1241.6741	954.9882	638.9690	418.9566	440.2500	692.8414	1052.3226	1400.4548	1694.9277	(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	786.6351	613.6829	518.0170	303.9505	136.5107	0.0000	0.0000	0.0000	0.0000	279.2320	551.2434	803.7055	(98)
Space heating												3992.9772	(98)
Space heating per m2											(98) / (4) =	33.0025	(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												4270.5639	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	786.6351	613.6829	518.0170	303.9505	136.5107	0.0000	0.0000	0.0000	0.0000	279.2320	551.2434	803.7055	(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)													
	841.3210	656.3454	554.0288	325.0807	146.0008	0.0000	0.0000	0.0000	0.0000	298.6439	589.5652	859.5781	(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													
	216.1094	190.4200	199.8425	178.9508	175.2249	156.3673	149.9813	164.8417	164.6339	185.5712	196.4675	210.8442	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9582	87.7148	87.2434	86.2161	84.1572	79.8000	79.8000	79.8000	79.8000	85.9014	87.4200	88.0465	(217)
Fuel for water heating, kWh/month													
	245.6956	217.0899	229.0631	207.5609	208.2114	195.9489	187.9465	206.5686	206.3081	216.0281	224.7397	239.4691	(219)
Water heating fuel used												2584.6299	(219)
Annual totals kWh/year													
Space heating fuel - main system												4270.5639	(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)												520.3087	(232)
Total delivered energy for all uses												7450.5025	(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	4270.5639	0.2160	922.4418	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2584.6299	0.2160	558.2801	(264)
Space and water heating			1480.7219	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	520.3087	0.5190	270.0402	(268)
Total CO2, kg/m2/year			1789.6871	(272)
Emissions per m2 for space and water heating			12.2384	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2319	(272b)
Emissions per m2 for pumps and fans			0.3217	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.2384 * 1.55) + 2.2319 + 0.3217, rounded to 2 d.p.			21.5200	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-08	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 8, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	11.89	**TER**	21.01
Environmental	89 B	**% DER<TER**	43.42		
CO_2 Emissions (t/year)	1.32	**DFEE**	42.45	**TFEE**	45.21
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.10		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	131.1900 (1b)	x	2.6500 (2b)	=	347.6535	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	347.6535	(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) =	0.1151	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3651	(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) =	0.3103	(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	0.3956	0.3879	0.3801	0.3413	0.3336	0.2948	0.2948	0.2870	0.3103	0.3336	0.3491	0.3646	(22b)
Effective ac	0.5783	0.5752	0.5722	0.5583	0.5556	0.5434	0.5434	0.5412	0.5481	0.5556	0.5609	0.5665	(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			1.9500	1.2000	2.3400			(26)
Window (Uw = 1.40)			16.6900	1.3258	22.1269			(27)
Velux (Uw = 1.40)			1.9200	1.3258	2.5455			(27a)
Main Type 3	110.8300	16.6900	94.1400	0.1700	16.0038	110.0000	10355.4000	(29a)
Corridor	3.2500	1.9500	1.3000	0.2257	0.2935	110.0000	143.0000	(29a)
PIJ	25.0600		25.0600	0.1800	4.5108	9.0000	225.5400	(30)
PIR	22.2200	1.9200	20.3000	0.1800	3.6540	9.0000	182.7000	(30)
Total net area of external elements Aum(A, m2)			161.3600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.4744			(33)
Party Wall 1			24.8500	0.0000	0.0000	20.0000	497.0000	(32)
Party Floor 1			131.1900			40.0000	5247.6000	(32d)
Party Ceilings 1			90.8100			30.0000	2724.3000	(32b)
Internal Wall 1			230.3700			9.0000	2073.3300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	21448.8700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		163.4947 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		24.2040 (36)
Total fabric heat loss	(33) + (36) =	75.6784 (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	66.3415	65.9928	65.6511	64.0459	63.7456	62.3475	62.3475	62.0886	62.8860	63.7456	64.3531	64.9883	(38)
Heat transfer coeff	142.0199	141.6712	141.3295	139.7243	139.4240	138.0259	138.0259	137.7670	138.5644	139.4240	140.0315	140.6667	(39)
Average = Sum(39)m / 12 =												139.7229	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0826	1.0799	1.0773	1.0651	1.0628	1.0521	1.0521	1.0501	1.0562	1.0628	1.0674	1.0722	(40)
HLP (average)												1.0650	(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	2.8980 (42)
Average daily hot water use (litres/day)	103.0277 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3305	109.2094	105.0883	100.9672	96.8461	92.7250	92.7250	96.8461	100.9672	105.0883	109.2094	113.3305	(44)
Energy conte	168.0659	146.9915	151.6820	132.2401	126.8875	109.4943	101.4625	116.4297	117.8203	137.3082	149.8826	162.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1621.0274	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

	25.2099	22.0487	22.7523	19.8360	19.0331	16.4241	15.2194	17.4645	17.6730	20.5962	22.4824	24.4144 (46)

Water storage loss:

Store volume 180.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)

Temperature factor from Table 2b 0.6000 (49)

Enter (49) or (54) in (55) 0.7200 (55)

Total storage loss

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)

If cylinder contains dedicated solar storage

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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

	213.6483	188.1627	197.2644	176.3521	172.4699	153.6063	147.0449	162.0121	161.9323	182.8906	193.9946	208.3452 (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

	213.6483	188.1627	197.2644	176.3521	172.4699	153.6063	147.0449	162.0121	161.9323	182.8906	193.9946	208.3452 (64)

Total per year (kWh/year) = Sum(64)m = 2157.7234 (64)

Heat gains from water heating, kWh/month

	92.3478	81.8116	86.9002	79.2594	78.6560	71.6964	70.2022	75.1788	74.4648	82.1209	85.1256	90.5846 (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	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	(66)

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

	28.4015	25.2260	20.5152	15.5313	11.6098	9.8015	10.5909	13.7664	18.4772	23.4611	27.3826	29.1909 (67)

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

	299.1491	302.2534	294.4308	277.7775	256.7557	236.9981	223.7989	220.6946	228.5172	245.1705	266.1923	285.9499 (68)

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

	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900 (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)

	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204 (71)

Water heating gains (Table 5)

	124.1234	121.7435	116.8013	110.0825	105.7204	99.5784	94.3578	101.0468	103.4234	110.3775	118.2300	121.7534 (72)

Total internal gains

	518.1442	515.6930	498.2174	469.8614	440.5561	412.8482	395.2177	401.9780	416.8880	445.4793	478.2750	503.3643 (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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	5.9400	46.7521	0.6300	0.7000	0.7700	84.8710	(78)
West	6.3300	19.6403	0.6300	0.7000	0.7700	37.9947	(80)
North	0.9600	16.7973	0.7400	0.7000	1.0000	7.5177	(82)
South	0.9600	42.0754	0.7400	0.7000	1.0000	18.8309	(82)

Solar gains	175.7445	314.4153	464.9260	625.6754	739.8635	750.0295	716.7738	630.3120	520.9736	357.3684	213.3711	148.4746	(83)
Total gains	693.8887	830.1082	963.1435	1095.5368	1180.4196	1162.8777	1111.9915	1032.2900	937.8615	802.8477	691.6461	651.8390	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.9520	42.0553	42.1570	42.6413	42.7331	43.1659	43.1659	43.2471	42.9982	42.7331	42.5477	42.3556	
alpha	3.7968	3.8037	3.8105	3.8428	3.8489	3.8777	3.8777	3.8831	3.8665	3.8489	3.8365	3.8237	
util living area	0.9933	0.9863	0.9693	0.9243	0.8293	0.6745	0.5211	0.5746	0.8021	0.9514	0.9877	0.9947	(86)
MIT	19.3135	19.5333	19.8802	20.3173	20.6799	20.9000	20.9719	20.9590	20.7943	20.3087	19.7288	19.2766	(87)
Th 2	20.0151	20.0173	20.0194	20.0295	20.0314	20.0401	20.0401	20.0418	20.0368	20.0314	20.0275	20.0236	(88)
util rest of house	0.9918	0.9832	0.9621	0.9058	0.7873	0.5981	0.4178	0.4704	0.7395	0.9358	0.9844	0.9935	(89)
MIT 2	17.7488	18.0699	18.5728	19.1996	19.6887	19.9583	20.0250	20.0179	19.8460	19.1997	18.3630	17.7004	(90)
Living area fraction									fLA = Living area / (4) =			0.1643	(91)
MIT	18.0058	18.3103	18.7876	19.3832	19.8515	20.1129	20.1806	20.1725	20.0017	19.3818	18.5874	17.9593	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0058	18.3103	18.7876	19.3832	19.8515	20.1129	20.1806	20.1725	20.0017	19.3818	18.5874	17.9593	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9754	0.9499	0.8906	0.7785	0.6044	0.4336	0.4854	0.7369	0.9221	0.9773	0.9896	(94)
Useful gains	684.9327	809.6832	914.9286	975.7333	918.9109	702.7986	482.1520	501.1059	691.0958	740.3044	675.9118	645.0654	(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	1946.4997	1899.8495	1736.5944	1464.7619	1136.5192	760.9292	494.2122	519.7237	817.7706	1224.3989	1608.5942	1935.4750	(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	938.6059	732.5918	611.3193	352.1005	161.9006	0.0000	0.0000	0.0000	0.0000	360.1663	671.5313	960.0648	(98)

Space heating 4788.2805 (98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 36.4988 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	4788.2805	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	5027.6945	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2157.7234	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2265.6095	(310a)
Electricity used for heat distribution	72.9330	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	501.5799	(332)
Total delivered energy for all uses	7794.8839	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2431.1014	0.5190	1261.7416	(367)
Electrical energy for heat distribution	72.9330	0.5190	37.8522	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1299.5938	(373)
Space and water heating			1299.5938	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	501.5799	0.5190	260.3200	(379)
Total CO2, kg/year			1559.9138	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			11.8900	(384)

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

DER		11.8900	ZC1
Total Floor Area	TFA	131.1900	
Assumed number of occupants	N	2.8980	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5124	ZC2
CO2 emissions from cooking, equation (L16)		1.4372	ZC3
Total CO2 emissions		26.8397	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		26.8397	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	131.1900 (1b)	x	2.6500 (2b)	=	347.6535	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	347.6535	(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) =	0.1151	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3651	(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) =	0.3103	(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	0.3956	0.3879	0.3801	0.3413	0.3336	0.2948	0.2948	0.2870	0.3103	0.3336	0.3491	0.3646	(22b)
Effective ac	0.5783	0.5752	0.5722	0.5583	0.5556	0.5434	0.5434	0.5412	0.5481	0.5556	0.5609	0.5665	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			16.6900	1.3258	22.1269			(27)
TER Room Window (Uw = 1.70)			1.9200	1.5918	3.0562			(27a)
Main Type 3	110.8300	16.6900	94.1400	0.1800	16.9452			(29a)
Corridor	3.2500	1.9500	1.3000	0.1800	0.2340			(29a)
PIJ	25.0600		25.0600	0.1300	3.2578			(30)
PIR	22.2200	1.9200	20.3000	0.1300	2.6390			(30)
Total net area of external elements Aum(A, m2)			161.3600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.2091			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.7972	(36)
Total fabric heat loss (33) + (36) =	66.0063	(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	66.3415	65.9928	65.6511	64.0459	63.7456	62.3475	62.3475	62.0886	62.8860	63.7456	64.3531	64.9883	(38)
Heat transfer coeff	132.3477	131.9991	131.6573	130.0522	129.7518	128.3538	128.3538	128.0949	128.8923	129.7518	130.3594	130.9946	(39)
Average = Sum(39)m / 12 =												130.0507	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0088	1.0062	1.0036	0.9913	0.9890	0.9784	0.9784	0.9764	0.9825	0.9890	0.9937	0.9985	(40)
HLP (average)												0.9913	(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	2.8980	(42)
Average daily hot water use (litres/day)	103.0277	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.3305	109.2094	105.0883	100.9672	96.8461	92.7250	92.7250	96.8461	100.9672	105.0883	109.2094	113.3305	(44)
Energy conte	168.0659	146.9915	151.6820	132.2401	126.8875	109.4943	101.4625	116.4297	117.8203	137.3082	149.8826	162.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1621.0274	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2099	22.0487	22.7523	19.8360	19.0331	16.4241	15.2194	17.4645	17.6730	20.5962	22.4824	24.4144	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	217.3085	191.4687	200.9247	179.8943	176.1302	157.1485	150.7052	165.6724	165.4745	186.5508	197.5368	212.0055	(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													
	217.3085	191.4687	200.9247	179.8943	176.1302	157.1485	150.7052	165.6724	165.4745	186.5508	197.5368	212.0055	(64)
									Total per year (kWh/year) = Sum(64)m =			2200.8201	(64)
Heat gains from water heating, kWh/month													
	95.2760	84.4565	89.8284	82.0932	81.5842	74.5302	73.1304	78.1070	77.2986	85.0491	87.9593	93.5128	(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	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	144.9005	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.4015	25.2260	20.5152	15.5313	11.6098	9.8015	10.5909	13.7664	18.4772	23.4611	27.3826	29.1909	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.1491	302.2534	294.4308	277.7775	256.7557	236.9981	223.7989	220.6946	228.5172	245.1705	266.1923	285.9499	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	37.4900	(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)													
	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	-115.9204	(71)
Water heating gains (Table 5)													
	128.0592	125.6793	120.7371	114.0183	109.6562	103.5142	98.2936	104.9826	107.3592	114.3133	122.1657	125.6892	(72)
Total internal gains													
	525.0800	522.6288	505.1532	476.7972	447.4918	419.7839	402.1535	408.9137	423.8238	452.4151	485.2108	510.3001	(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	4.4200	19.6403	0.6300	0.7000	0.7700	26.5303	(76)
South	5.9400	46.7521	0.6300	0.7000	0.7700	84.8710	(78)
West	6.3300	19.6403	0.6300	0.7000	0.7700	37.9947	(80)
North	0.9600	16.7973	0.6300	0.7000	1.0000	6.4002	(82)
South	0.9600	42.0754	0.6300	0.7000	1.0000	16.0317	(82)

Solar gains	171.8278	307.1026	453.0349	607.4821	716.1116	724.9076	693.1995	611.1586	506.9633	348.7957	208.5675	145.1930	(83)
Total gains	696.9078	829.7314	958.1881	1084.2794	1163.6035	1144.6915	1095.3530	1020.0723	930.7871	801.2107	693.7783	655.4931	(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	68.8370	69.0188	69.1979	70.0520	70.2142	70.9790	70.9790	71.1224	70.6824	70.2142	69.8869	69.5481	
alpha	5.5891	5.6013	5.6132	5.6701	5.6809	5.7319	5.7319	5.7415	5.7122	5.6809	5.6591	5.6365	
util living area													
	0.9989	0.9969	0.9895	0.9589	0.8653	0.6837	0.5099	0.5669	0.8310	0.9783	0.9973	0.9992	(86)
MIT	19.8875	20.0457	20.2933	20.6064	20.8527	20.9713	20.9954	20.9919	20.9144	20.5829	20.1747	19.8621	(87)
Th 2	20.0760	20.0782	20.0804	20.0906	20.0925	20.1014	20.1014	20.1030	20.0980	20.0925	20.0886	20.0846	(88)
util rest of house													
	0.9986	0.9958	0.9858	0.9441	0.8207	0.6014	0.4088	0.4619	0.7622	0.9678	0.9962	0.9990	(89)
MIT 2	18.5779	18.8106	19.1718	19.6245	19.9478	20.0823	20.0996	20.0996	20.0291	19.5996	19.0072	18.5470	(90)
Living area fraction										fLA = Living area / (4) =		0.1643	(91)
MIT	18.7930	19.0135	19.3560	19.7858	20.0964	20.2283	20.2468	20.2462	20.1745	19.7612	19.1989	18.7630	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7930	19.0135	19.3560	19.7858	20.0964	20.2283	20.2468	20.2462	20.1745	19.7612	19.1989	18.7630	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9940	0.9818	0.9379	0.8210	0.6137	0.4255	0.4791	0.7687	0.9627	0.9946	0.9984	(94)
Useful gains	695.3586	824.7485	940.7295	1016.9730	955.2618	702.4676	466.0223	488.7476	715.5405	771.2895	690.0380	654.4482	(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													
	1918.1218	1862.9690	1692.5917	1415.7185	1089.4538	722.4168	468.0792	492.6794	782.9582	1188.6770	1577.2112	1907.6774	(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													
	909.7358	697.6842	559.3854	287.0967	99.8388	0.0000	0.0000	0.0000	0.0000	310.5363	638.7647	932.4026	(98)
Space heating												4435.4446	(98)
Space heating per m2											(98) / (4) =	33.8093	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4743.7910	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	909.7358	697.6842	559.3854	287.0967	99.8388	0.0000	0.0000	0.0000	0.0000	310.5363	638.7647	932.4026	(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)	972.9795	746.1863	598.2732	307.0553	106.7795	0.0000	0.0000	0.0000	0.0000	332.1244	683.1708	997.2220	(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	217.3085	191.4687	200.9247	179.8943	176.1302	157.1485	150.7052	165.6724	165.4745	186.5508	197.5368	212.0055	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.2192	87.9603	87.4029	86.0551	83.3658	79.8000	79.8000	79.8000	79.8000	86.1642	87.7217	88.3065	(217)
Fuel for water heating, kWh/month	246.3278	217.6764	229.8832	209.0456	211.2738	196.9279	188.8536	207.6095	207.3615	216.5063	225.1857	240.0792	(219)
Water heating fuel used												2596.7305	(219)
Annual totals kWh/year													
Space heating fuel - main system												4743.7910	(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)												501.5799	(232)
Total delivered energy for all uses												7917.1014	(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	4743.7910	0.2160	1024.6589	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2596.7305	0.2160	560.8938	(264)
Space and water heating			1585.5526	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	501.5799	0.5190	260.3200	(268)
Total CO2, kg/m2/year			1884.7976	(272)
Emissions per m2 for space and water heating			12.0859	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.9843	(272b)
Emissions per m2 for pumps and fans			0.2967	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0859 * 1.55) + 1.9843 + 0.2967, rounded to 2 d.p.			21.0100	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-09	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 9, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	86 B	**DER**	10.19	**TER**	18.78
Environmental	91 B	**% DER<TER**	45.75		
CO_2 Emissions (t/year)	1.25	**DFEE**	33.45	**TFEE**	38.73
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.65		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	144.4200 (1b)	x	2.6500 (2b)	=	382.7130	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	144.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	382.7130	(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) =	0.1045	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3545	(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) =	0.3013	(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	0.3842	0.3767	0.3691	0.3315	0.3239	0.2863	0.2863	0.2787	0.3013	0.3239	0.3390	0.3541	(22b)
Effective ac	0.5738	0.5709	0.5681	0.5549	0.5525	0.5410	0.5410	0.5388	0.5454	0.5525	0.5575	0.5627	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			15.6900	1.3258	20.8011			(27)
Main Type 3	63.4700	15.6900	47.7800	0.1700	8.1226	110.0000	5255.8000	(29a)
Corridor	6.6800	1.7200	4.9600	0.2257	1.1196	110.0000	545.6000	(29a)
PIJ	39.7100		39.7100	0.1600	6.3536	9.0000	357.3900	(30)
Total net area of external elements Aum(A, m2)			109.8600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4610			(33)
Party Wall 1			65.1600	0.0000	0.0000	20.0000	1303.2000	(32)
Party Floor 1			144.7200			40.0000	5788.8000	(32d)
Party Ceilings 1			104.7200			30.0000	3141.6000	(32b)
Internal Wall 1			253.8700			9.0000	2284.8300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18677.2200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	129.3257	(35)
Thermal bridges (User defined value 0.150 * total exposed area)	16.4790	(36)
Total fabric heat loss	(33) + (36) = 54.9400	(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	72.4692	72.1073	71.7525	70.0860	69.7742	68.3227	68.3227	68.0539	68.8818	69.7742	70.4049	71.0644	(38)
Heat transfer coeff	127.4092	127.0472	126.6924	125.0259	124.7141	123.2627	123.2627	122.9939	123.8218	124.7141	125.3449	126.0043	(39)
Average = Sum(39)m / 12 =												125.0244	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8822	0.8797	0.8772	0.8657	0.8636	0.8535	0.8535	0.8516	0.8574	0.8636	0.8679	0.8725	(40)
HLP (average)												0.8657	(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	2.9251	(42)
Average daily hot water use (litres/day)	103.6704	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.0374	109.8906	105.7438	101.5970	97.4502	93.3033	93.3033	97.4502	101.5970	105.7438	109.8906	114.0374	(44)
Energy conte	169.1142	147.9084	152.6282	133.0649	127.6790	110.1772	102.0954	117.1560	118.5552	138.1647	150.8175	163.7781	(45)
Energy content (annual)										Total = Sum(45)m =		1631.1387	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3671	22.1863	22.8942	19.9597	19.1518	16.5266	15.3143	17.5734	17.7833	20.7247	22.6226	24.5667	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Water storage loss:
Store volume                                                
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8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	4139.0991	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	4346.0540	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2167.8347	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2276.2264	(310a)
Electricity used for heat distribution	66.2228	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	561.5252	(332)
Total delivered energy for all uses	7183.8057	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2207.4268	0.5190	1145.6545	(367)
Electrical energy for heat distribution	66.2228	0.5190	34.3696	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1180.0242	(373)
Space and water heating			1180.0242	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	561.5252	0.5190	291.4316	(379)
Total CO2, kg/year			1471.4558	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			10.1900	(384)

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

DER		10.1900	ZC1
Total Floor Area	TFA	144.4200	
Assumed number of occupants	N	2.9251	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.8997	ZC2
CO2 emissions from cooking, equation (L16)		1.3101	ZC3
Total CO2 emissions		24.3998	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		24.3998	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	144.4200 (1b)	x	2.6500 (2b)	=	382.7130	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	144.4200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	382.7130	(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) =	0.1045	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3545	(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) =	0.3013	(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	0.3842	0.3767	0.3691	0.3315	0.3239	0.2863	0.2863	0.2787	0.3013	0.3239	0.3390	0.3541	(22b)
Effective ac	0.5738	0.5709	0.5681	0.5549	0.5525	0.5410	0.5410	0.5388	0.5454	0.5525	0.5575	0.5627	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			15.6900	1.3258	20.8011			(27)
Main Type 3	63.4700	15.6900	47.7800	0.1800	8.6004			(29a)
Corridor	6.6800	1.7200	4.9600	0.1800	0.8928			(29a)
PIJ	39.7100		39.7100	0.1300	5.1623			(30)
Total net area of external elements Aum(A, m2)			109.8600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.1766			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.4825	(36)
Total fabric heat loss					(33) + (36) =		53.6591	(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	72.4692	72.1073	71.7525	70.0860	69.7742	68.3227	68.3227	68.0539	68.8818	69.7742	70.4049	71.0644	(38)
Heat transfer coeff	126.1284	125.7664	125.4116	123.7451	123.4333	121.9819	121.9819	121.7131	122.5409	123.4333	124.0641	124.7235	(39)
Average = Sum(39)m / 12 =												123.7436	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8733	0.8708	0.8684	0.8568	0.8547	0.8446	0.8446	0.8428	0.8485	0.8547	0.8591	0.8636	(40)
HLP (average)												0.8568	(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		2.9251 (42)
Average daily hot water use (litres/day)		103.6704 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.0374	109.8906	105.7438	101.5970	97.4502	93.3033	93.3033	97.4502	101.5970	105.7438	109.8906	114.0374	(44)
Energy conte	169.1142	147.9084	152.6282	133.0649	127.6790	110.1772	102.0954	117.1560	118.5552	138.1647	150.8175	163.7781	(45)
Energy content (annual)										Total = Sum(45)m =		1631.1387	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3671	22.1863	22.8942	19.9597	19.1518	16.5266	15.3143	17.5734	17.7833	20.7247	22.6226	24.5667	(46)

Water storage loss:		
Store volume		180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5520 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8381 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (56)
If cylinder contains dedicated solar storage
25.9803 23.4661 25.9803 25.1422 25.9803 25.1422 25.9803 25.9803 25.1422 25.9803 25.1422 25.9803 (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
218.3569 192.3856 201.8708 180.7191 176.9216 157.8314 151.3381 166.3987 166.2094 187.4073 198.4717 213.0207 (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
218.3569 192.3856 201.8708 180.7191 176.9216 157.8314 151.3381 166.3987 166.2094 187.4073 198.4717 213.0207 (64)
Total per year (kWh/year) = Sum(64)m = 2210.9314 (64)
Heat gains from water heating, kWh/month
95.6246 84.7613 90.1430 82.3674 81.8474 74.7573 73.3409 78.3485 77.5430 85.3339 88.2702 93.8503 (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	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	146.2534	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
31.7959 28.2408 22.9670 17.3875 12.9973 10.9729 11.8566 15.4117 20.6855 26.2650 30.6552 32.6796 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
314.3839 317.6462 309.4253 291.9239 269.8315 249.0677 235.1963 231.9340 240.1549 257.6563 279.7487 300.5125 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 37.6253 (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)
-117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 -117.0027 (71)
Water heating gains (Table 5)
128.5277 126.1329 121.1599 114.3992 110.0099 103.8296 98.5764 105.3071 107.6986 114.6961 122.5975 126.1429 (72)
Total internal gains
544.5835 541.8960 523.4283 493.5866 462.7148 433.7463 415.5054 422.5288 438.4150 468.4935 502.8774 529.2110 (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	
South	10.3600	46.7521	0.6300	0.7000	0.7700	148.0241	(78)
West	5.3300	19.6403	0.6300	0.7000	0.7700	31.9924	(80)

Solar gains	180.0164	305.0092	411.8735	499.3354	547.9178	538.5915	521.5184	486.3310	442.4560	335.7394	215.3497	154.2154	(83)
Total gains	724.6000	846.9052	935.3018	992.9220	1010.6326	972.3378	937.0238	908.8598	880.8710	804.2329	718.2271	683.4264	(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	79.5156	79.7444	79.9700	81.0470	81.2517	82.2185	82.2185	82.4001	81.8434	81.2517	80.8386	80.4112	
alpha	6.3010	6.3163	6.3313	6.4031	6.4168	6.4812	6.4812	6.4933	6.4562	6.4168	6.3892	6.3607	
util living area	0.9992	0.9976	0.9927	0.9745	0.9136	0.7556	0.5661	0.6056	0.8475	0.9808	0.9978	0.9995	(86)
MIT	20.0534	20.1916	20.3900	20.6361	20.8456	20.9683	20.9957	20.9935	20.9319	20.6599	20.3079	20.0310	(87)
Th 2	20.1902	20.1924	20.1945	20.2043	20.2062	20.2148	20.2148	20.2164	20.2115	20.2062	20.2024	20.1985	(88)
util rest of house	0.9989	0.9968	0.9902	0.9649	0.8811	0.6812	0.4687	0.5079	0.7865	0.9718	0.9970	0.9993	(89)
MIT 2	18.9060	19.1096	19.4000	19.7608	20.0457	20.1921	20.2130	20.2135	20.1550	19.7993	19.2877	18.8797	(90)
Living area fraction									fLA = Living area / (4) =			0.2109	(91)
MIT	19.1480	19.3378	19.6088	19.9454	20.2144	20.3558	20.3781	20.3780	20.3189	19.9808	19.5029	19.1225	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1480	19.3378	19.6088	19.9454	20.2144	20.3558	20.3781	20.3780	20.3189	19.9808	19.5029	19.1225	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9985	0.9957	0.9877	0.9610	0.8815	0.6954	0.4893	0.5285	0.7958	0.9684	0.9959	0.9989	(94)
Useful gains	723.4790	843.2363	923.7762	954.1933	890.8578	676.1899	458.4920	480.3472	700.9948	778.8407	715.2725	682.6874	(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	1872.7546	1815.7876	1643.9947	1366.8185	1050.9582	702.1047	460.8597	484.1715	762.0638	1157.9065	1538.7540	1861.1886	(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	855.0611	653.5545	535.8426	297.0902	119.1147	0.0000	0.0000	0.0000	0.0000	282.0250	592.9067	876.8049	(98)
Space heating												4212.3996	(98)
Space heating per m2											(98) / (4) =	29.1677	(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												4505.2402	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	855.0611	653.5545	535.8426	297.0902	119.1147	0.0000	0.0000	0.0000	0.0000	282.0250	592.9067	876.8049	(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)													
	914.5038	698.9888	573.0937	317.7435	127.3954	0.0000	0.0000	0.0000	0.0000	301.6310	634.1248	937.7592	(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													
	218.3569	192.3856	201.8708	180.7191	176.9216	157.8314	151.3381	166.3987	166.2094	187.4073	198.4717	213.0207	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.0971	87.8220	87.2969	86.1319	83.7859	79.8000	79.8000	79.8000	79.8000	85.9017	87.5557	88.1887	(217)
Fuel for water heating, kWh/month													
	247.8594	219.0632	231.2462	209.8168	211.1592	197.7838	189.6467	208.5196	208.2824	218.1648	226.6805	241.5511	(219)
Water heating fuel used												2609.7737	(219)
Annual totals kWh/year													
Space heating fuel - main system												4505.2402	(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)												561.5252	(232)
Total delivered energy for all uses												7751.5392	(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	4505.2402	0.2160	973.1319	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2609.7737	0.2160	563.7111	(264)
Space and water heating			1536.8430	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	561.5252	0.5190	291.4316	(268)
Total CO2, kg/m2/year			1867.1996	(272)
Emissions per m2 for space and water heating			10.6415	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0179	(272b)
Emissions per m2 for pumps and fans			0.2695	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.6415 * 1.55) + 2.0179 + 0.2695, rounded to 2 d.p.			18.7800	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-10	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 10, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	85 B	**DER**	11.21	**TER**	21.30
Environmental	90 B	**% DER<TER**	47.36		
CO_2 Emissions (t/year)	1.09	**DFEE**	34.54	**TFEE**	41.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.64		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	115.2400 (1b)	x	2.6500 (2b)	=	305.3860	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.2400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.3860	(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) =	0.1310	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3810	(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) =	0.3238	(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	0.4129	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5664	0.5724	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
Main Type 3	31.1100	12.5700	18.5400	0.1700	3.1518	110.0000	2039.4000	(29a)
Corridor	18.6000	1.7200	16.8800	0.2257	3.8104	110.0000	1856.8000	(29a)
PIJ	17.6100		17.6100	0.1600	2.8176	9.0000	158.4900	(30)
Total net area of external elements Aum(A, m2)			67.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.5086			(33)
Party Wall 1			71.2900	0.0000	0.0000	20.0000	1425.8000	(32)
Party Floor 1			115.2400			40.0000	4609.6000	(32d)
Party Ceilings 1			97.6300			30.0000	2928.9000	(32b)
Internal Wall 1			209.7700			9.0000	1887.9300	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14906.9200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		129.3554 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		10.0980 (36)
Total fabric heat loss	(33) + (36) =	38.6066 (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	58.9788	58.6453	58.3183	56.7826	56.4952	55.1577	55.1577	54.9100	55.6729	56.4952	57.0765	57.6842	(38)
Heat transfer coeff	97.5854	97.2518	96.9249	95.3891	95.1018	93.7642	93.7642	93.5165	94.2794	95.1018	95.6831	96.2907	(39)

Average = Sum(39)m / 12 = 95.3878 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8468	0.8439	0.8411	0.8277	0.8252	0.8136	0.8136	0.8115	0.8181	0.8252	0.8303	0.8356	(40)
HLP (average)												0.8277	(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	2.8429 (42)
Average daily hot water use (litres/day)	101.7185 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8904	107.8216	103.7529	99.6841	95.6154	91.5467	91.5467	95.6154	99.6841	103.7529	107.8216	111.8904	(44)
Energy conte	165.9302	145.1236	149.7545	130.5596	125.2751	108.1029	100.1732	114.9502	116.3231	135.5633	147.9780	160.6945	(45)
Energy content (annual)										Total = Sum(45)m =		1600.4281	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8895	21.7685	22.4632	19.5839	18.7913	16.2154	15.0260	17.2425	17.4485	20.3345	22.1967	24.1042	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 0.7200 (55)
Total storage loss

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)

If cylinder contains dedicated solar storage

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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

	211.5126	186.2948	195.3369	174.6716	170.8575	152.2149	145.7556	160.5326	160.4351	181.1457	192.0900	206.2769 (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

	211.5126	186.2948	195.3369	174.6716	170.8575	152.2149	145.7556	160.5326	160.4351	181.1457	192.0900	206.2769 (64)

Total per year (kWh/year) = Sum(64)m = 2137.1241 (64)

Heat gains from water heating, kWh/month

	91.6377	81.1906	86.2593	78.7007	78.1199	71.2338	69.7735	74.6869	73.9670	81.5407	84.4923	89.8968 (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	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	142.1442	(66)

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

	28.1807	25.0298	20.3556	15.4105	11.5195	9.7253	10.5085	13.6594	18.3336	23.2787	27.1696	28.9639	(67)

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

	278.8800	281.7739	274.4813	258.9564	239.3589	220.9401	208.6351	205.7412	213.0338	228.5587	248.1562	266.5751	(68)

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

	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	37.2144	(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)

	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	-113.7154	(71)

Water heating gains (Table 5)

	123.1690	120.8193	115.9399	109.3065	104.9998	98.9358	93.7816	100.3856	102.7320	109.5978	117.3504	120.8291	(72)

Total internal gains

	495.8729	493.2662	476.4201	449.3167	421.5216	395.2445	378.5685	385.4294	399.7426	427.0784	458.3195	482.0113	(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	12.5700	10.6334	0.6300	0.7000	0.7700	40.8488	(74)

Solar gains	40.8488	78.0641	132.6499	213.0698	287.0246	307.2683	286.8742	227.5981	159.4882	92.9251	50.3922	34.0535	(83)
Total gains	536.7216	571.3303	609.0701	662.3865	708.5461	702.5128	665.4428	613.0276	559.2308	520.0035	508.7117	516.0648	(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	42.4327	42.5782	42.7219	43.4097	43.5408	44.1619	44.1619	44.2789	43.9206	43.5408	43.2763	43.0032	
alpha	3.8288	3.8385	3.8481	3.8940	3.9027	3.9441	3.9441	3.9519	3.9280	3.9027	3.8851	3.8669	
util living area	0.9904	0.9866	0.9769	0.9475	0.8737	0.7306	0.5805	0.6393	0.8525	0.9597	0.9851	0.9918	(86)
MIT	19.4113	19.5489	19.8253	20.2334	20.6134	20.8730	20.9616	20.9440	20.7462	20.2861	19.7944	19.3942	(87)
Th 2	20.2130	20.2154	20.2179	20.2294	20.2315	20.2415	20.2415	20.2434	20.2377	20.2315	20.2272	20.2226	(88)
util rest of house	0.9887	0.9843	0.9725	0.9367	0.8461	0.6724	0.4944	0.5546	0.8105	0.9494	0.9820	0.9903	(89)
MIT 2	18.0468	18.2490	18.6526	19.2480	19.7795	20.1203	20.2149	20.2018	19.9694	19.3304	18.6155	18.0283	(90)
Living area fraction									fLA = Living area / (4) =			0.2165	(91)
MIT	18.3422	18.5304	18.9065	19.4614	19.9600	20.2833	20.3766	20.3625	20.1376	19.5373	18.8707	18.3240	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3422	18.5304	18.9065	19.4614	19.9600	20.2833	20.3766	20.3625	20.1376	19.5373	18.8707	18.3240	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9771	0.9626	0.9232	0.8349	0.6759	0.5105	0.5688	0.8041	0.9373	0.9745	0.9852	(94)
Useful gains	527.6017	558.2567	586.2927	611.5273	591.5744	474.8147	339.7103	348.7035	449.6628	487.4064	495.7238	508.4431	(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	1370.3176	1325.5823	1202.5006	1007.4383	785.5421	532.8871	354.1080	370.5570	569.2197	849.9525	1126.2603	1360.0092	(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	626.9807	515.6428	458.4587	285.0560	144.3120	0.0000	0.0000	0.0000	0.0000	269.7343	453.9863	633.5652	(98)
Space heating												3387.7359	(98)
Space heating per m2										(98) / (4) =		29.3972	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	3387.7359	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	3557.1227	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2137.1241	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2243.9804	(310a)
Electricity used for heat distribution	58.0110	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	497.6793	(332)
Total delivered energy for all uses	6298.7824	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	1933.7010	0.5190	1003.5908	(367)
Electrical energy for heat distribution	58.0110	0.5190	30.1077	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1033.6986	(373)
Space and water heating			1033.6986	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	497.6793	0.5190	258.2956	(379)
Total CO2, kg/year			1291.9941	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2100	(384)

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

DER		11.2100	ZC1
Total Floor Area	TFA	115.2400	
Assumed number of occupants	N	2.8429	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3404	ZC2
CO2 emissions from cooking, equation (L16)		1.6247	ZC3
Total CO2 emissions		27.1751	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		27.1751	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	115.2400 (1b)	x	2.6500 (2b)	=	305.3860	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.2400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	305.3860	(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) =	0.1310	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3810	(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) =	0.3238	(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	0.4129	0.4048	0.3967	0.3562	0.3481	0.3076	0.3076	0.2995	0.3238	0.3481	0.3643	0.3805	(22b)
Effective ac	0.5852	0.5819	0.5787	0.5634	0.5606	0.5473	0.5473	0.5449	0.5524	0.5606	0.5664	0.5724	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			12.5700	1.3258	16.6648			(27)
Main Type 3	31.1100	12.5700	18.5400	0.1800	3.3372			(29a)
Corridor	18.6000	1.7200	16.8800	0.1800	3.0384			(29a)
PIJ	17.6100		17.6100	0.1300	2.2893			(30)
Total net area of external elements Aum(A, m2)			67.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0497			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6143	(36)
Total fabric heat loss						(33) + (36) =	39.6640	(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	58.9788	58.6453	58.3183	56.7826	56.4952	55.1577	55.1577	54.9100	55.6729	56.4952	57.0765	57.6842	(38)
Heat transfer coeff	98.6428	98.3092	97.9823	96.4465	96.1592	94.8217	94.8217	94.5740	95.3369	96.1592	96.7405	97.3482	(39)
Average = Sum(39)m / 12 =												96.4452	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8560	0.8531	0.8502	0.8369	0.8344	0.8228	0.8228	0.8207	0.8273	0.8344	0.8395	0.8447	(40)
HLP (average)												0.8369	(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		2.8429 (42)
Average daily hot water use (litres/day)		101.7185 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8904	107.8216	103.7529	99.6841	95.6154	91.5467	91.5467	95.6154	99.6841	103.7529	107.8216	111.8904	(44)
Energy conte	165.9302	145.1236	149.7545	130.5596	125.2751	108.1029	100.1732	114.9502	116.3231	135.5633	147.9780	160.6945	(45)
Energy content (annual)										Total = Sum(45)m =		1600.4281	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8895	21.7685	22.4632	19.5839	18.7913	16.2154	15.0260	17.2425	17.4485	20.3345	22.1967	24.1042	(46)

Water storage loss:		
Store volume		180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5520 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8381 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Total storage loss
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (56)
If cylinder contains dedicated solar storage
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (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
             215.1728   189.6008   198.9972   178.2138   174.5177   155.7571   149.4159   164.1929   163.9773   184.8060   195.6322   209.9372 (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
             215.1728   189.6008   198.9972   178.2138   174.5177   155.7571   149.4159   164.1929   163.9773   184.8060   195.6322   209.9372 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   2180.2209 (64)
Heat gains from water heating, kWh/month
              94.5659    83.8354    89.1875    81.5344    81.0481    74.0676    72.7017    77.6151    76.8008    84.4689    87.3260    92.8251 (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       142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442   142.1442 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              28.1807    25.0298    20.3556    15.4105    11.5195     9.7253    10.5085    13.6594    18.3336    23.2787    27.1696    28.9639 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             278.8800   281.7739   274.4813   258.9564   239.3589   220.9401   208.6351   205.7412   213.0338   228.5587   248.1562   266.5751 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144    37.2144 (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)
            -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154  -113.7154 (71)
Water heating gains (Table 5)
             127.1047   124.7550   119.8757   113.2423   108.9356   102.8716    97.7174   104.3213   106.6678   113.5335   121.2862   124.7649 (72)
Total internal gains
             502.8086   500.2020   483.3559   456.2524   428.4573   402.1802   385.5043   392.3652   406.6784   434.0142   465.2553   488.9471 (73)
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6. Solar gains

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[Jan]                                    Area          Solar flux              g                FF            Access              Gains
                                         m2              Table 6a      Specific data    Specific data        factor                W
                                                            W/m2        or Table 6b      or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------------------------------------
North                                 12.5700             10.6334            0.6300           0.7000            0.7700            40.8488 (74)
-----------------------------------------------------------------------------------------------------------------------------------------

Solar gains    40.8488    78.0641   132.6499   213.0698   287.0246   307.2683   286.8742   227.5981   159.4882    92.9251    50.3922    34.0535 (83)
Total gains   543.6574   578.2661   616.0059   669.3223   715.4819   709.4486   672.3785   619.9633   566.1666   526.9393   515.6475   523.0006 (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          81.1289    81.4041    81.6758    82.9763    83.2242    84.3982    84.3982    84.6193    83.9421    83.2242    82.7242    82.2078
alpha         6.4086     6.4269     6.4451     6.5318     6.5483     6.6265     6.6265     6.6413     6.5961     6.5483     6.5149     6.4805
util living area
              0.9994     0.9990     0.9974     0.9885     0.9430     0.7923     0.6103     0.6804     0.9239     0.9928     0.9988     0.9996 (86)

MIT          20.0494    20.1341    20.3049    20.5632    20.8101    20.9612    20.9940    20.9885    20.8833    20.5876    20.2833    20.0398 (87)
Th 2         20.2051    20.2076    20.2100    20.2215    20.2236    20.2336    20.2336    20.2355    20.2297    20.2236    20.2193    20.2147 (88)
util rest of house
              0.9993     0.9987     0.9964     0.9838     0.9186     0.7209     0.5094     0.5781     0.8817     0.9891     0.9983     0.9994 (89)
MIT 2        18.9115    19.0373    19.2889    19.6728    20.0180    20.2047    20.2310    20.2299    20.1217    19.7117    19.2648    18.9049 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.2165 (91)
MIT          19.1579    19.2748    19.5089    19.8656    20.1895    20.3685    20.3962    20.3942    20.2866    19.9013    19.4853    19.1507 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT 19.1579    19.2748    19.5089    19.8656    20.1895    20.3685    20.3962    20.3942    20.2866    19.9013    19.4853    19.1507 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9989     0.9981     0.9952     0.9809     0.9174     0.7345     0.5314     0.6002     0.8854     0.9869     0.9977     0.9992 (94)
Useful gains 543.0629   577.1695   613.0586   656.5350   656.3591   521.0593   357.2803   372.1207   501.2977   520.0386   514.4363   522.5592 (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
            1465.6244  1413.1742  1274.6405  1057.5910   816.3436   546.9796   359.9654   377.7443   589.8097   894.4089  1198.1629  1455.4188 (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
             686.3857   561.7952   492.2169   288.7603   119.0285     0.0000     0.0000     0.0000     0.0000   278.5315   492.2831   694.0476 (98)
Space heating                                                                                                                    3613.0488 (98)
Space heating per m2                                                                                                  (98) / (4) =     31.3524 (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												3864.2233	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	686.3857	561.7952	492.2169	288.7603	119.0285	0.0000	0.0000	0.0000	0.0000	278.5315	492.2831	694.0476	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	734.1024	600.8505	526.4352	308.8346	127.3032	0.0000	0.0000	0.0000	0.0000	297.8946	526.5060	742.2969	(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													
	215.1728	189.6008	198.9972	178.2138	174.5177	155.7571	149.4159	164.1929	163.9773	184.8060	195.6322	209.9372	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6936	87.5382	87.1363	86.0944	83.8184	79.8000	79.8000	79.8000	79.8000	85.9057	87.1758	87.7670	(217)
Fuel for water heating, kWh/month													
	245.3688	216.5920	228.3746	206.9982	208.2095	195.1843	187.2379	205.7555	205.4853	215.1266	224.4110	239.1983	(219)
Water heating fuel used												2577.9419	(219)
Annual totals kWh/year													
Space heating fuel - main system												3864.2233	(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)												497.6793	(232)
Total delivered energy for all uses												7014.8446	(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	3864.2233	0.2160	834.6722	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2577.9419	0.2160	556.8355	(264)
Space and water heating			1391.5077	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	497.6793	0.5190	258.2956	(268)
Total CO2, kg/m2/year			1688.7283	(272)
Emissions per m2 for space and water heating			12.0749	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2414	(272b)
Emissions per m2 for pumps and fans			0.3378	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0749 * 1.55) + 2.2414 + 0.3378, rounded to 2 d.p.			21.3000	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-11	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 11, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	84 B	**DER**	12.83	**TER**	25.17
Environmental	89 B	**% DER<TER**	49.04		
CO_2 Emissions (t/year)	1.04	**DFEE**	39.87	**TFEE**	51.01
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.83		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	95.6000 (1b)	x	2.6500 (2b)	=	253.3400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.3400	(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) =	0.1579	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4079	(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) =	0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3900	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			9.2600	1.3258	12.2765			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Main Type 3	60.2900	9.2600	51.0300	0.1700	8.6751	110.0000	5613.3000	(29a)
Corridor	5.4600	1.7200	3.7400	0.2257	0.8442	110.0000	411.4000	(29a)
PIJ	34.1300	2.5100	31.6200	0.1600	5.0592	9.0000	284.5800	(30)
Total net area of external elements Aum(A, m2)			99.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.2467			(33)
Party Wall 1			61.2900	0.0000	0.0000	20.0000	1225.8000	(32)
Party Floor 1			95.6000			40.0000	3824.0000	(32d)
Party Ceilings 1			61.4800			30.0000	1844.4000	(32b)
Internal Wall 1			168.4900			9.0000	1516.4100	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14719.8900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							153.9737	(35)
Thermal bridges (User defined value 0.150 * total exposed area)							14.9820	(36)
Total fabric heat loss					(33) + (36) =		47.2287	(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	49.9694	49.6522	49.3413	47.8810	47.6078	46.3359	46.3359	46.1004	46.8258	47.6078	48.1605	48.7384	(38)
Heat transfer coeff	97.1981	96.8810	96.5700	95.1097	94.8365	93.5646	93.5646	93.3291	94.0545	94.8365	95.3892	95.9671	(39)
Average = Sum(39)m / 12 =												95.1084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0167	1.0134	1.0101	0.9949	0.9920	0.9787	0.9787	0.9762	0.9838	0.9920	0.9978	1.0038	(40)
HLP (average)												0.9949	(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	2.6949	(42)
Average daily hot water use (litres/day)	98.2036	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0240	104.0959	100.1677	96.2396	92.3114	88.3833	88.3833	92.3114	96.2396	100.1677	104.0959	108.0240	(44)
Energy conte	160.1965	140.1089	144.5798	126.0482	120.9462	104.3674	96.7117	110.9781	112.3036	130.8790	142.8646	155.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1545.1257	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.0295	21.0163	21.6870	18.9072	18.1419	15.6551	14.5068	16.6467	16.8455	19.6318	21.4297	23.2713	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	205.7789	181.2801	190.1622	170.1602	166.5286	148.4794	142.2941	156.5605	156.4156	176.4614	186.9766	200.7241	(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													
	205.7789	181.2801	190.1622	170.1602	166.5286	148.4794	142.2941	156.5605	156.4156	176.4614	186.9766	200.7241	(64)
Total per year (kWh/year) = Sum(64)m =												2081.8217	(64)
Heat gains from water heating, kWh/month													
	89.7312	79.5232	84.5387	77.2006	76.6805	69.9918	68.6226	73.3661	72.6305	79.9832	82.7921	88.0505	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	134.7445	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2699	21.5563	17.5307	13.2719	9.9209	8.3756	9.0502	11.7638	15.7893	20.0481	23.3991	24.9444	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.0121	251.5960	245.0845	231.2223	213.7237	197.2775	186.2904	183.7065	190.2180	204.0802	221.5788	238.0250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	36.4745	(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)													
	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	-107.7956	(71)
Water heating gains (Table 5)													
	120.6065	118.3380	113.6273	107.2231	103.0652	97.2108	92.2346	98.6104	100.8757	107.5043	114.9890	118.3475	(72)
Total internal gains													
	457.3118	454.9137	439.6659	415.1406	390.1332	366.2873	350.9986	357.5040	370.3063	395.0560	423.3903	444.7402	(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	9.2600	10.6334	0.6300	0.7000	0.7700	30.0922	(74)
East	2.5100	26.6072	0.7400	0.7000	1.0000	31.1348	(82)

Solar gains	61.2270	120.4533	206.4820	323.6419	422.9082	446.0230	419.1509	341.3543	246.6021	144.4837	76.3093	50.4570	(83)
Total gains	518.5388	575.3670	646.1479	738.7825	813.0414	812.3102	770.1495	698.8583	616.9084	539.5397	499.6996	495.1973	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	42.0672	42.2050	42.3409	42.9910	43.1148	43.7009	43.7009	43.8112	43.4733	43.1148	42.8650	42.6069	
alpha	3.8045	3.8137	3.8227	3.8661	3.8743	3.9134	3.9134	3.9207	3.8982	3.8743	3.8577	3.8405	
util living area													
	0.9911	0.9858	0.9713	0.9270	0.8259	0.6615	0.5121	0.5757	0.8155	0.9538	0.9854	0.9925	(86)
MIT	19.3785	19.5478	19.8686	20.3148	20.6902	20.9092	20.9744	20.9602	20.7848	20.3059	19.7754	19.3560	(87)
Th 2	20.0694	20.0722	20.0749	20.0876	20.0900	20.1011	20.1011	20.1032	20.0968	20.0900	20.0852	20.0801	(88)
util rest of house													
	0.9892	0.9828	0.9649	0.9102	0.7862	0.5901	0.4166	0.4782	0.7587	0.9399	0.9818	0.9910	(89)
MIT 2	17.8861	18.1341	18.6005	19.2442	19.7527	20.0246	20.0865	20.0785	19.8895	19.2432	18.4754	17.8603	(90)
Living area fraction									fLA = Living area / (4) =			0.2610	(91)
MIT	18.2756	18.5031	18.9314	19.5236	19.9974	20.2555	20.3183	20.3086	20.1232	19.5205	18.8147	18.2507	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2756	18.5031	18.9314	19.5236	19.9974	20.2555	20.3183	20.3086	20.1232	19.5205	18.8147	18.2507	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9840	0.9757	0.9545	0.8975	0.7817	0.6031	0.4405	0.5016	0.7606	0.9286	0.9747	0.9864	(94)
Useful gains	510.2400	561.3637	616.7181	663.0933	635.5170	489.9030	339.2147	350.5764	469.2330	501.0260	487.0594	488.4571	(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													
	1358.4037	1317.8805	1200.5049	1010.4093	786.8953	529.1506	347.8981	364.7849	566.5096	845.9903	1117.4559	1348.4008	(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													
	631.0338	508.3793	434.3374	250.0675	112.6254	0.0000	0.0000	0.0000	0.0000	256.6534	453.8855	639.7981	(98)
Space heating												3286.7805	(98)
Space heating per m2											(98) / (4) =	34.3805	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	3286.7805	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	3451.1195	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2081.8217	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2185.9127	(310a)
Electricity used for heat distribution	56.3703	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	428.6132	(332)
Total delivered energy for all uses	6065.6454	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	1879.0108	0.5190	975.2066	(367)
Electrical energy for heat distribution	56.3703	0.5190	29.2562	(372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1004.4628	(373)
Space and water heating			1004.4628	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	428.6132	0.5190	222.4502	(379)
Total CO2, kg/year			1226.9130	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.8300	(384)

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

DER		12.8300	ZC1
Total Floor Area	TFA	95.6000	
Assumed number of occupants	N	2.6949	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4351	ZC2
CO2 emissions from cooking, equation (L16)		1.9213	ZC3
Total CO2 emissions		30.1864	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		30.1864	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	95.6000 (1b)	x	2.6500 (2b)	=	253.3400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	253.3400	(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) =	0.1184	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3684	(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) =	0.3132	(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	0.3993	0.3914	0.3836	0.3445	0.3366	0.2975	0.2975	0.2897	0.3132	0.3366	0.3523	0.3680	(22b)
Effective ac	0.5797	0.5766	0.5736	0.5593	0.5567	0.5443	0.5443	0.5420	0.5490	0.5567	0.5621	0.5677	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			9.2600	1.3258	12.2765			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Main Type 3	60.2900	9.2600	51.0300	0.1800	9.1854			(29a)
Corridor	5.4600	1.7200	3.7400	0.1800	0.6732			(29a)
PIJ	34.1300	2.5100	31.6200	0.1300	4.1106			(30)
Total net area of external elements Aum(A, m2)			99.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.9610			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.3140	(36)
Total fabric heat loss						(33) + (36) =	52.2750	(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	48.4650	48.2062	47.9526	46.7612	46.5383	45.5007	45.5007	45.3085	45.9004	46.5383	46.9892	47.4607	(38)
Heat transfer coeff	100.7400	100.4813	100.2276	99.0363	98.8134	97.7757	97.7757	97.5836	98.1754	98.8134	99.2643	99.7357	(39)
Average = Sum(39)m / 12 =												99.0352	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0538	1.0511	1.0484	1.0359	1.0336	1.0228	1.0228	1.0207	1.0269	1.0336	1.0383	1.0433	(40)
HLP (average)												1.0359	(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												2.6949	(42)
Average daily hot water use (litres/day)												98.2036	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0240	104.0959	100.1677	96.2396	92.3114	88.3833	88.3833	92.3114	96.2396	100.1677	104.0959	108.0240	(44)
Energy conte	160.1965	140.1089	144.5798	126.0482	120.9462	104.3674	96.7117	110.9781	112.3036	130.8790	142.8646	155.1417	(45)
Energy content (annual)										Total = Sum(45)m =		1545.1257	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0295	21.0163	21.6870	18.9072	18.1419	15.6551	14.5068	16.6467	16.8455	19.6318	21.4297	23.2713	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Enter (49) or (54) in (55)                                                                                    0.8381 (55)
Total storage loss
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (56)
If cylinder contains dedicated solar storage
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (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
             209.4391   184.5861   193.8225   173.7024   170.1889   152.0216   145.9544   160.2208   159.9578   180.1216   190.5188   204.3844 (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
             209.4391   184.5861   193.8225   173.7024   170.1889   152.0216   145.9544   160.2208   159.9578   180.1216   190.5188   204.3844 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   2124.9184 (64)
Heat gains from water heating, kWh/month
              92.6595    82.1680    87.4669    80.0344    79.6088    72.8255    71.5508    76.2944    75.4643    82.9114    85.6258    90.9788 (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        134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445   134.7445 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.2699    21.5563    17.5307    13.2719     9.9209     8.3756     9.0502    11.7638    15.7893    20.0481    23.3991    24.9444 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             249.0121   251.5960   245.0845   231.2223   213.7237   197.2775   186.2904   183.7065   190.2180   204.0802   221.5788   238.0250 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745    36.4745 (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)
            -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956  -107.7956 (71)
Water heating gains (Table 5)
             124.5423   122.2738   117.5631   111.1589   107.0010   101.1465    96.1704   102.5462   104.8115   111.4400   118.9248   122.2833 (72)
Total internal gains
             464.2476   461.8494   446.6017   422.0764   397.0690   373.2230   357.9344   364.4398   377.2421   401.9917   430.3261   451.6760 (73)


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6. Solar gains
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[Jan]                                Area          Solar flux              g                FF            Access            Gains
                                     m2             Table 6a       Specific data    Specific data        factor                W
                                                       W/m2       or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
North                              9.2600            10.6334            0.6300           0.7000         0.7700           30.0922 (74)
East                               2.5100            26.6072            0.6300           0.7000         1.0000           26.5066 (82)
-------------------------------------------------------------------------------------------------------------

Solar gains     56.5989   111.0965   190.3146   298.8653   391.4743   413.3699   388.2591   315.5357   227.4099   133.1822    70.4843    46.6857 (83)
Total gains    520.8464   572.9460   636.9163   720.9417   788.5433   786.5929   746.1934   679.9755   604.6520   535.1739   500.8103   498.3617 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            65.9012    66.0709    66.2381    67.0349    67.1861    67.8991    67.8991    68.0329    67.6227    67.1861    66.8809    66.5648
alpha           5.3934     5.4047     5.4159     5.4690     5.4791     5.5266     5.5266     5.5355     5.5082     5.4791     5.4587     5.4377
util living area
                0.9988     0.9976     0.9935     0.9743     0.9025     0.7363     0.5646     0.6360     0.8901     0.9864     0.9975     0.9990 (86)

MIT            19.8379    19.9534    20.1787    20.5025    20.7919    20.9531    20.9910    20.9835    20.8601    20.4984    20.1173    19.8201 (87)
Th 2           20.0388    20.0410    20.0432    20.0535    20.0554    20.0644    20.0644    20.0661    20.0609    20.0554    20.0515    20.0474 (88)
util rest of house
                0.9983     0.9968     0.9911     0.9641     0.8644     0.6513     0.4508     0.5189     0.8322     0.9793     0.9964     0.9987 (89)
MIT 2          18.4783    18.6486    18.9787    19.4517    19.8437    20.0320    20.0609    20.0588    19.9402    19.4524    18.8962    18.4585 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.2610 (91)
MIT            18.8331    18.9891    19.2919    19.7259    20.0912    20.2724    20.3037    20.3002    20.1803    19.7254    19.2149    18.8139 (92)
Temperature adjustment                                                                                                        0.0000
adjusted MIT   18.8331    18.9891    19.2919    19.7259    20.0912    20.2724    20.3037    20.3002    20.1803    19.7254    19.2149    18.8139 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9976     0.9955     0.9885     0.9595     0.8661     0.6715     0.4807     0.5496     0.8409     0.9759     0.9951     0.9981 (94)
Useful gains   519.5714   570.3703   629.5848   691.7497   682.9383   528.2110   358.6690   373.6894   508.4272   522.2562   498.3525   497.4025 (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
            1464.0667  1415.6953  1282.0996  1072.1577   829.1613   554.6259   362.1285   380.5910   596.9344   901.7070  1202.5780  1457.5247 (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
             702.7045   568.0584   485.4711   273.8938   108.7899     0.0000     0.0000     0.0000     0.0000   282.3114   507.0423   714.3309 (98)
Space heating                                                                                                                3642.6023 (98)
Space heating per m2                                                                                                 (98) / (4) =    38.1025 (99)


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8c. Space cooling requirement
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Not applicable
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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												3895.8313	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.7045	568.0584	485.4711	273.8938	108.7899	0.0000	0.0000	0.0000	0.0000	282.3114	507.0423	714.3309	(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)													
	751.5556	607.5491	519.2204	292.9345	116.3529	0.0000	0.0000	0.0000	0.0000	301.9374	542.2913	763.9903	(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													
	209.4391	184.5861	193.8225	173.7024	170.1889	152.0216	145.9544	160.2208	159.9578	180.1216	190.5188	204.3844	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7969	87.6187	87.1652	86.0237	83.6570	79.8000	79.8000	79.8000	79.8000	86.0080	87.3028	87.8786	(217)
Fuel for water heating, kWh/month													
	238.5495	210.6697	222.3622	201.9238	203.4364	190.5032	182.9003	200.7779	200.4483	209.4242	218.2275	232.5758	(219)
Water heating fuel used												2511.7990	(219)
Annual totals kWh/year													
Space heating fuel - main system												3895.8313	(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)												428.6132	(232)
Total delivered energy for all uses												6911.2435	(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	3895.8313	0.2160	841.4996	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2511.7990	0.2160	542.5486	(264)
Space and water heating			1384.0481	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	428.6132	0.5190	222.4502	(268)
Total CO2, kg/m2/year			1645.4234	(272)
Emissions per m2 for space and water heating			14.4775	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3269	(272b)
Emissions per m2 for pumps and fans			0.4072	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4775 * 1.55) + 2.3269 + 0.4072, rounded to 2 d.p.			25.1700	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-12	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Mid
Property	Plot 12, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	84 B	**DER**	13.09	**TER**	25.37
Environmental	89 B	**% DER<TER**	48.40		
CO_2 Emissions (t/year)	1.06	**DFEE**	40.48	**TFEE**	51.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.16		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	96.2900 (1b)	x	2.6500 (2b)	=	255.1685	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.1685	(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) =	0.1568	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4068	(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) =	0.3457	(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	0.4408	0.4322	0.4235	0.3803	0.3717	0.3285	0.3285	0.3198	0.3457	0.3717	0.3890	0.4063	(22b)
Effective ac	0.5972	0.5934	0.5897	0.5723	0.5691	0.5539	0.5539	0.5511	0.5598	0.5691	0.5756	0.5825	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			8.8500	1.3258	11.7330			(27)
Velux (Uw = 1.40)			0.6300	1.3258	0.8352			(27a)
Main Type 3	65.0900	8.8500	56.2400	0.1700	9.5608	110.0000	6186.4000	(29a)
Corridor	18.0700	1.7200	16.3500	0.2257	3.6907	110.0000	1798.5000	(29a)
PIJ	36.8400	0.6300	36.2100	0.1600	5.7936	9.0000	325.8900	(30)
Total net area of external elements Aum(A, m2)			120.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6773			(33)
Party Wall 1			61.2900	0.0000	0.0000	20.0000	1225.8000	(32)
Party Floor 1			96.2900			40.0000	3851.6000	(32d)
Party Ceilings 1			59.4500			30.0000	1783.5000	(32b)
Internal Wall 1			168.4900			9.0000	1516.4100	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16688.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		173.3108 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		18.0000 (36)
Total fabric heat loss	(33) + (36) =	51.6773 (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	50.2845	49.9668	49.6554	48.1927	47.9190	46.6450	46.6450	46.4091	47.1358	47.9190	48.4726	49.0514	(38)
Heat transfer coeff	101.9618	101.6441	101.3327	99.8700	99.5963	98.3224	98.3224	98.0865	98.8131	99.5963	100.1500	100.7288	(39)
Average = Sum(39)m / 12 =												99.8687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0589	1.0556	1.0524	1.0372	1.0343	1.0211	1.0211	1.0187	1.0262	1.0343	1.0401	1.0461	(40)
HLP (average)												1.0372	(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	2.7024 (42)
Average daily hot water use (litres/day)	98.3826 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.2208	104.2855	100.3502	96.4149	92.4796	88.5443	88.5443	92.4796	96.4149	100.3502	104.2855	108.2208	(44)
Energy conte	160.4884	140.3642	144.8432	126.2779	121.1666	104.5576	96.8880	111.1803	112.5082	131.1175	143.1250	155.4244	(45)
Energy content (annual)										Total = Sum(45)m =		1547.9412	(45)
Distribution loss (46)m = 0.15 x (45)m													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.0733	21.0546	21.7265	18.9417	18.1750	15.6836	14.5332	16.6771	16.8762	19.6676	21.4687	23.3137	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	206.0708	181.5354	190.4256	170.3899	166.7490	148.6696	142.4704	156.7627	156.6202	176.6999	187.2370	201.0068	(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													
	206.0708	181.5354	190.4256	170.3899	166.7490	148.6696	142.4704	156.7627	156.6202	176.6999	187.2370	201.0068	(64)
								Total per year (kWh/year) = Sum(64)m =				2084.6372	(64)
Heat gains from water heating, kWh/month													
	89.8283	79.6080	84.6263	77.2770	76.7538	70.0550	68.6812	73.4334	72.6986	80.0625	82.8786	88.1445	(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	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	135.1212	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.7666	22.8857	18.6119	14.0904	10.5327	8.8922	9.6083	12.4892	16.7630	21.2845	24.8422	26.4827	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	250.1867	252.7829	246.2407	232.3130	214.7319	198.2081	187.1692	184.5731	191.1153	205.0429	222.6241	239.1478	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	36.5121	(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)													
	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	-108.0970	(71)
Water heating gains (Table 5)													
	120.7370	118.4644	113.7450	107.3291	103.1637	97.2986	92.3134	98.7008	100.9702	107.6109	115.1092	118.4739	(72)
Total internal gains													
	460.2267	457.6693	442.1339	417.2689	391.9647	367.9353	352.6273	359.2995	372.3849	397.4747	426.1118	447.6408	(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	3.3200	19.6403	0.6300	0.7000	0.7700	19.9277	(76)
South	5.5300	46.7521	0.6300	0.7000	0.7700	79.0129	(78)
East	0.6300	26.6072	0.7400	0.7000	1.0000	7.8147	(82)

Solar gains	106.7553	184.1846	256.3341	321.7669	361.9613	359.4303	346.5372	316.9325	279.2634	204.9121	128.3404	91.0299	(83)
Total gains	566.9819	641.8539	698.4680	739.0358	753.9260	727.3656	699.1645	676.2320	651.6483	602.3868	554.4522	538.6707	(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	45.4639	45.6060	45.7462	46.4162	46.5437	47.1468	47.1468	47.2602	46.9126	46.5437	46.2864	46.0205	
alpha	4.0309	4.0404	4.0497	4.0944	4.1029	4.1431	4.1431	4.1507	4.1275	4.1029	4.0858	4.0680	
util living area													
	0.9920	0.9860	0.9736	0.9435	0.8770	0.7433	0.5835	0.6199	0.8227	0.9517	0.9859	0.9935	(86)
MIT	19.4989	19.6778	19.9592	20.3235	20.6490	20.8822	20.9672	20.9575	20.8067	20.3874	19.8818	19.4720	(87)
Th 2	20.0345	20.0373	20.0399	20.0525	20.0548	20.0658	20.0658	20.0678	20.0616	20.0548	20.0501	20.0451	(88)
util rest of house													
	0.9902	0.9828	0.9670	0.9284	0.8416	0.6691	0.4743	0.5131	0.7624	0.9358	0.9820	0.9920	(89)
MIT 2	18.0237	18.2854	18.6946	19.2234	19.6714	19.9670	20.0480	20.0430	19.8822	19.3217	18.5925	17.9916	(90)
Living area fraction									fLA = Living area / (4) =			0.2214	(91)
MIT	18.3503	18.5937	18.9746	19.4670	19.8879	20.1697	20.2516	20.2455	20.0869	19.5576	18.8779	18.3194	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3503	18.5937	18.9746	19.4670	19.8879	20.1697	20.2516	20.2455	20.0869	19.5576	18.8779	18.3194	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9855	0.9759	0.9574	0.9167	0.8342	0.6781	0.4972	0.5348	0.7642	0.9251	0.9752	0.9879	(94)
Useful gains	558.7364	626.3826	668.6943	677.5085	628.9587	493.2409	347.6191	361.6325	498.0060	557.2475	540.7118	532.1768	(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													
	1432.5980	1391.8873	1264.0900	1055.3271	815.4833	547.6214	359.0298	377.1872	591.5814	892.1488	1179.5605	1422.2247	(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													
	650.1530	514.4192	442.9744	272.0294	138.7743	0.0000	0.0000	0.0000	0.0000	249.1666	459.9711	662.1956	(98)
Space heating												3389.6835	(98)
Space heating per m2											(98) / (4) =	35.2029	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	3389.6835	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	3559.1677	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2084.6372	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2188.8690	(310a)
Electricity used for heat distribution	57.4804	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	455.0461	(332)
Total delivered energy for all uses	6203.0829	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	1916.0123	0.5190	994.4104	(367)
Electrical energy for heat distribution	57.4804	0.5190	29.8323	(372)
Total CO2 associated with community systems			1024.2427	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1024.2427	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	455.0461	0.5190	236.1689	(379)
Total CO2, kg/year			1260.4116	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			13.0900	(384)

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

DER		13.0900	ZC1
Total Floor Area	TFA	96.2900	
Assumed number of occupants	N	2.7024	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3968	ZC2
CO2 emissions from cooking, equation (L16)		1.9094	ZC3
Total CO2 emissions		30.3962	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		30.3962	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	96.2900 (1b)	x	2.6500 (2b)	=	255.1685	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	255.1685	(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) =	0.1176	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3676	(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) =	0.3124	(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	0.3984	0.3905	0.3827	0.3437	0.3359	0.2968	0.2968	0.2890	0.3124	0.3359	0.3515	0.3671	(22b)
Effective ac	0.5793	0.5763	0.5732	0.5591	0.5564	0.5440	0.5440	0.5418	0.5488	0.5564	0.5618	0.5674	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			8.8500	1.3258	11.7330			(27)
TER Room Window (Uw = 1.70)			0.6300	1.5918	1.0028			(27a)
Main Type 3	65.0900	8.8500	56.2400	0.1800	10.1232			(29a)
Corridor	18.0700	1.7200	16.3500	0.1800	2.9430			(29a)
PIJ	36.8400	0.6300	36.2100	0.1300	4.7073			(30)
Total net area of external elements Aum(A, m2)			120.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.2293			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							24.9980	(36)
Total fabric heat loss					(33) + (36) =		57.2273	(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	48.7839	48.5245	48.2702	47.0757	46.8523	45.8120	45.8120	45.6193	46.2127	46.8523	47.3043	47.7770	(38)
Heat transfer coeff	106.0112	105.7517	105.4974	104.3030	104.0795	103.0392	103.0392	102.8466	103.4399	104.0795	104.5316	105.0042	(39)
Average = Sum(39)m / 12 =												104.3019	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1010	1.0983	1.0956	1.0832	1.0809	1.0701	1.0701	1.0681	1.0743	1.0809	1.0856	1.0905	(40)
HLP (average)												1.0832	(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												2.7024	(42)
Average daily hot water use (litres/day)												98.3826	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.2208	104.2855	100.3502	96.4149	92.4796	88.5443	88.5443	92.4796	96.4149	100.3502	104.2855	108.2208	(44)
Energy conte	160.4884	140.3642	144.8432	126.2779	121.1666	104.5576	96.8880	111.1803	112.5082	131.1175	143.1250	155.4244	(45)
Energy content (annual)										Total = Sum(45)m =		1547.9412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0733	21.0546	21.7265	18.9417	18.1750	15.6836	14.5332	16.6771	16.8762	19.6676	21.4687	23.3137	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Enter (49) or (54) in (55)                                                                                    0.8381 (55)
Total storage loss
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (56)
If cylinder contains dedicated solar storage
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (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
             209.7311   184.8414   194.0859   173.9321   170.4093   152.2118   146.1306   160.4230   160.1624   180.3601   190.7792   204.6671 (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
             209.7311   184.8414   194.0859   173.9321   170.4093   152.2118   146.1306   160.4230   160.1624   180.3601   190.7792   204.6671 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2127.7339 (64)
Heat gains from water heating, kWh/month
              92.7565    82.2529    87.5545    80.1107    79.6820    72.8887    71.6094    76.3616    75.5323    82.9907    85.7124    91.0728 (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      135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212   135.1212 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              25.7666    22.8857    18.6119    14.0904    10.5327     8.8922     9.6083    12.4892    16.7630    21.2845    24.8422    26.4827 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             250.1867   252.7829   246.2407   232.3130   214.7319   198.2081   187.1692   184.5731   191.1153   205.0429   222.6241   239.1478 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121    36.5121 (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)
            -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970  -108.0970 (71)
Water heating gains (Table 5)
             124.6727   122.4001   117.6808   111.2649   107.0995   101.2344    96.2492   102.6366   104.9060   111.5466   119.0450   122.4096 (72)
Total internal gains
             467.1625   464.6051   449.0697   424.2047   398.9005   374.8710   359.5631   366.2352   379.3207   404.4104   433.0476   454.5766 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                         m2            Table 6a       Specific data    Specific data        factor                W
                                                          W/m2       or Table 6b      or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
East                                    3.3200           19.6403            0.6300           0.7000           0.7700           19.9277 (76)
South                                   5.5300           46.7521            0.6300           0.7000           0.7700           79.0129 (78)
East                                    0.6300           26.6072            0.6300           0.7000           1.0000            6.6531 (82)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains  105.5936   181.8361   252.2761   315.5480   354.0715   351.2345   338.7835   310.4522   274.4462   202.0755   126.8783    90.0833 (83)
Total gains  572.7561   646.4411   701.3459   739.7528   752.9720   726.1056   698.3466   676.6874   653.7669   606.4859   559.9259   544.6599 (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          63.0764    63.2312    63.3836    64.1094    64.2471    64.8957    64.8957    65.0173    64.6443    64.2471    63.9692    63.6813
alpha         5.2051     5.2154     5.2256     5.2740     5.2831     5.3264     5.3264     5.3345     5.3096     5.2831     5.2646     5.2454
util living area
              0.9981     0.9960     0.9907     0.9744     0.9258     0.7988     0.6248     0.6644     0.8760     0.9788     0.9959     0.9985 (86)

MIT          19.8203    19.9575    20.1776    20.4656    20.7324    20.9214    20.9831    20.9767    20.8605    20.5172    20.1164    19.7968 (87)
Th 2         20.0001    20.0023    20.0044    20.0146    20.0165    20.0253    20.0253    20.0270    20.0219    20.0165    20.0126    20.0086 (88)
util rest of house
              0.9975     0.9947     0.9873     0.9640     0.8932     0.7155     0.4987     0.5407     0.8129     0.9682     0.9943     0.9981 (89)
MIT 2        18.4245    18.6263    18.9479    19.3694    19.7372    19.9681    20.0186    20.0166    19.9044    19.4481    18.8663    18.3964 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.2214 (91)
MIT          18.7335    18.9211    19.2202    19.6121    19.9576    20.1791    20.2321    20.2292    20.1161    19.6848    19.1431    18.7064 (92)
Temperature adjustment                                                                                                        0.0000
adjusted MIT 18.7335    18.9211    19.2202    19.6121    19.9576    20.1791    20.2321    20.2292    20.1161    19.6848    19.1431    18.7064 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9962     0.9925     0.9836     0.9585     0.8909     0.7301     0.5268     0.5680     0.8200     0.9634     0.9922     0.9971 (94)
Useful gains 570.5983   641.6109   689.8666   709.0358   670.7926   530.1543   367.8654   384.3412   536.1212   584.3029   555.5311   543.0683 (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
            1530.1148  1482.7525  1341.9489  1117.3013   859.4456   574.8704   374.2523   393.8192   622.3059   945.5460  1258.8800  1523.2379 (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
             713.8802   565.2471   485.1492   293.9512   140.3578     0.0000     0.0000     0.0000     0.0000   268.7649   506.4112   729.2462 (98)
Space heating                                                                                                              3703.0078 (98)
Space heating per m2                                                                                        (98) / (4) =     38.4568 (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												3960.4361	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	713.8802	565.2471	485.1492	293.9512	140.3578	0.0000	0.0000	0.0000	0.0000	268.7649	506.4112	729.2462	(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)													
	763.5083	604.5424	518.8761	314.3863	150.1153	0.0000	0.0000	0.0000	0.0000	287.4491	541.6163	779.9424	(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													
	209.7311	184.8414	194.0859	173.9321	170.4093	152.2118	146.1306	160.4230	160.1624	180.3601	190.7792	204.6671	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.8259	87.6053	87.1606	86.2032	84.3017	79.8000	79.8000	79.8000	79.8000	85.8759	87.2970	87.9166	(217)
Fuel for water heating, kWh/month													
	238.8032	210.9933	222.6763	201.7699	202.1423	190.7416	183.1211	201.0314	200.7048	210.0241	218.5404	232.7969	(219)
Water heating fuel used												2513.3451	(219)
Annual totals kWh/year													
Space heating fuel - main system												3960.4361	(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)												455.0461	(232)
Total delivered energy for all uses												7003.8274	(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	3960.4361	0.2160	855.4542	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2513.3451	0.2160	542.8825	(264)
Space and water heating			1398.3368	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	455.0461	0.5190	236.1689	(268)
Total CO2, kg/m2/year			1673.4307	(272)
Emissions per m2 for space and water heating			14.5221	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4527	(272b)
Emissions per m2 for pumps and fans			0.4042	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5221 * 1.55) + 2.4527 + 0.4042, rounded to 2 d.p.			25.3700	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-13	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Top
Property	Plot 13, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	83 B	**DER**	13.51	**TER**	26.09
Environmental	88 B	**% DER<TER**	48.21		
CO_2 Emissions (t/year)	1.25	**DFEE**	47.56	**TFEE**	56.82
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.30		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	105.3600 (1b)	x	2.5000 (2b)	=	263.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.4000	(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) =	0.1519	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4019	(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) =	0.3416	(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	0.4355	0.4270	0.4184	0.3757	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014	(22b)
Effective ac	0.5948	0.5912	0.5875	0.5706	0.5674	0.5527	0.5527	0.5499	0.5583	0.5674	0.5738	0.5805	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Main Type 3	60.9100	10.2600	50.6500	0.1300	6.5845	9.0000	455.8500	(29a)
Corridor	15.9400	1.7200	14.2200	0.2257	3.2099	110.0000	1564.2000	(29a)
Fl	41.5500	2.5100	39.0400	0.1300	5.0752	9.0000	351.3600	(30)
PIR	92.5200		92.5200	0.1300	12.0276	9.0000	832.6800	(30)
Total net area of external elements Aum(A, m2)			210.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8912			(33)
Party Wall 1			20.1200	0.0000	0.0000	20.0000	402.4000	(32)
Party Floor 1			105.3600			40.0000	4214.4000	(32d)
Party Ceilings 1			59.4500			30.0000	1783.5000	(32b)
Internal Wall 1			195.9800			9.0000	1763.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11368.2100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		107.8987 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		31.6380 (36)
Total fabric heat loss	(33) + (36) =	77.5292 (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	51.7044	51.3843	51.0706	49.5968	49.3211	48.0375	48.0375	47.7998	48.5319	49.3211	49.8789	50.4621	(38)
Heat transfer coeff	129.2336	128.9135	128.5997	127.1260	126.8503	125.5667	125.5667	125.3290	126.0611	126.8503	127.4081	127.9912	(39)
Average = Sum(39)m / 12 =												127.1247	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2266	1.2236	1.2206	1.2066	1.2040	1.1918	1.1918	1.1895	1.1965	1.2040	1.2093	1.2148	(40)
HLP (average)												1.2066	(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		2.7839 (42)
Average daily hot water use (litres/day)		100.3180 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3498	106.3370	102.3243	98.3116	94.2989	90.2862	90.2862	94.2989	98.3116	102.3243	106.3370	110.3498	(44)
Energy conte	163.6455	143.1254	147.6926	128.7620	123.5502	106.6144	98.7939	113.3675	114.7214	133.6968	145.9405	158.4819	(45)
Energy content (annual)										Total = Sum(45)m =		1578.3921	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

	24.5468	21.4688	22.1539	19.3143	18.5325	15.9922	14.8191	17.0051	17.2082	20.0545	21.8911	23.7723 (46)

Water storage loss:

Store volume 180.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)

Temperature factor from Table 2b 0.6000 (49)

Enter (49) or (54) in (55) 0.7200 (55)

Total storage loss

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)

If cylinder contains dedicated solar storage

	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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

	209.2279	184.2966	193.2750	172.8740	169.1326	150.7264	144.3763	158.9499	158.8334	179.2792	190.0525	204.0643 (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

	209.2279	184.2966	193.2750	172.8740	169.1326	150.7264	144.3763	158.9499	158.8334	179.2792	190.0525	204.0643 (64)

Total per year (kWh/year) = Sum(64)m = 2115.0881 (64)

Heat gains from water heating, kWh/month

	90.8780	80.5262	85.5737	78.1030	77.5464	70.7389	69.3149	74.1606	73.4345	80.9201	83.8148	89.1612 (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	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	(66)

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

	25.9088	23.0120	18.7146	14.1682	10.5909	8.9413	9.6613	12.5582	16.8556	21.4020	24.9793	26.6289 (67)

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

	264.7132	267.4601	260.5380	245.8017	227.1998	209.7166	198.0367	195.2898	202.2119	216.9482	235.5501	253.0333 (68)

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

	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196 (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)

	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566 (71)

Water heating gains (Table 5)

	122.1479	119.8306	115.0184	108.4763	104.2290	98.2485	93.1652	99.6782	101.9923	108.7636	116.4095	119.8403 (72)

Total internal gains

	477.5286	475.0614	459.0297	433.2049	406.7783	381.6650	365.6220	372.2849	385.8185	411.8725	441.6976	464.2612 (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	3.2400	19.6403	0.6300	0.7000	0.7700	19.4475	(76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554	(78)
West	1.6200	19.6403	0.6300	0.7000	0.7700	9.7238	(80)
West	2.5100	26.6072	0.7400	0.7000	1.0000	31.1348	(82)

Solar gains	137.4615	246.3713	363.7015	485.6614	569.0117	574.0559	549.7760	487.4171	406.5546	280.0327	167.0153	116.0291 (83)
Total gains	614.9901	721.4327	822.7312	918.8663	975.7900	955.7209	915.3979	859.7021	792.3731	691.9052	608.7129	580.2903 (84)

---

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.4351	24.4958	24.5555	24.8402	24.8942	25.1487	25.1487	25.1964	25.0500	24.8942	24.7852	24.6723	
alpha	2.6290	2.6331	2.6370	2.6560	2.6596	2.6766	2.6766	2.6798	2.6700	2.6596	2.6523	2.6448	
util living area	0.9734	0.9587	0.9319	0.8792	0.7916	0.6623	0.5301	0.5723	0.7605	0.9057	0.9606	0.9770	(86)
MIT	18.5378	18.8131	19.2632	19.8394	20.3523	20.7275	20.8927	20.8650	20.5740	19.8985	19.1166	18.4907	(87)
Th 2	19.8988	19.9012	19.9036	19.9147	19.9168	19.9266	19.9266	19.9284	19.9228	19.9168	19.9126	19.9082	(88)
util rest of house	0.9689	0.9519	0.9202	0.8571	0.7502	0.5892	0.4241	0.4683	0.6991	0.8838	0.9529	0.9731	(89)
MIT 2	16.6152	17.0146	17.6642	18.4887	19.1942	19.6794	19.8577	19.8357	19.5024	18.5883	17.4654	16.5522	(90)

Living area fraction fLA = Living area / (4) = 0.1875 (91)

MIT	16.9756	17.3518	17.9639	18.7419	19.4113	19.8759	20.0517	20.0287	19.7033	18.8339	17.7750	16.9156	(92)

Temperature adjustment 0.0000

adjusted MIT	16.9756	17.3518	17.9639	18.7419	19.4113	19.8759	20.0517	20.0287	19.7033	18.8339	17.7750	16.9156	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9291	0.8922	0.8271	0.7276	0.5854	0.4375	0.4790	0.6845	0.8550	0.9308	0.9569	(94)
Useful gains	584.8974	670.2767	734.0022	759.9652	710.0193	559.4895	400.4610	411.7658	542.3879	591.5621	566.6103	555.2947	(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	1638.1166	1605.1988	1474.2547	1251.1594	978.1797	662.4764	433.4191	454.7769	706.3546	1044.4750	1360.0759	1627.4804	(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	783.5951	628.2677	550.7479	353.6598	199.5114	0.0000	0.0000	0.0000	0.0000	336.9672	571.2952	797.7062	(98)

Space heating 4221.7504 (98)

Space heating per m2 (98) / (4) = 40.0698 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	4221.7504	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	4432.8379	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2115.0881	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2220.8425	(310a)
Electricity used for heat distribution	66.5368	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	457.5577	(332)
Total delivered energy for all uses	7111.2382	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2217.8935	0.5190	1151.0867	(367)
Electrical energy for heat distribution	66.5368	0.5190	34.5326	(372)
Total CO2 associated with community systems			1185.6193	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1185.6193	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	457.5577	0.5190	237.4725	(379)
Total CO2, kg/year			1423.0918	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			13.5100	(384)

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

DER		13.5100	ZC1
Total Floor Area	TFA	105.3600	
Assumed number of occupants	N	2.7839	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8883	ZC2
CO2 emissions from cooking, equation (L16)		1.7636	ZC3
Total CO2 emissions		30.1619	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		30.1619	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	105.3600 (1b)	x	2.5000 (2b)	=	263.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.4000	(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) =	0.1519	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4019	(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) =	0.3416	(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	0.4355	0.4270	0.4184	0.3757	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014	(22b)
Effective ac	0.5948	0.5912	0.5875	0.5706	0.5674	0.5527	0.5527	0.5499	0.5583	0.5674	0.5738	0.5805	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Main Type 3	60.9100	10.2600	50.6500	0.1800	9.1170			(29a)
Corridor	15.9400	1.7200	14.2200	0.1800	2.5596			(29a)
Fl	41.5500	2.5100	39.0400	0.1300	5.0752			(30)
PIR	92.5200		92.5200	0.1300	12.0276			(30)
Total net area of external elements Aum(A, m2)			210.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.0970			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.7638	(36)
Total fabric heat loss (33) + (36) =	75.8608	(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	51.7044	51.3843	51.0706	49.5968	49.3211	48.0375	48.0375	47.7998	48.5319	49.3211	49.8789	50.4621	(38)
Heat transfer coeff	127.5652	127.2451	126.9314	125.4576	125.1819	123.8983	123.8983	123.6606	124.3927	125.1819	125.7397	126.3228	(39)
Average = Sum(39)m / 12 =												125.4563	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2108	1.2077	1.2047	1.1908	1.1881	1.1760	1.1760	1.1737	1.1806	1.1881	1.1934	1.1990	(40)
HLP (average)												1.1907	(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	2.7839 (42)
Average daily hot water use (litres/day)	100.3180 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3498	106.3370	102.3243	98.3116	94.2989	90.2862	90.2862	94.2989	98.3116	102.3243	106.3370	110.3498	(44)
Energy conte	163.6455	143.1254	147.6926	128.7620	123.5502	106.6144	98.7939	113.3675	114.7214	133.6968	145.9405	158.4819	(45)
Energy content (annual)										Total = Sum(45)m =		1578.3921	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5468	21.4688	22.1539	19.3143	18.5325	15.9922	14.8191	17.0051	17.2082	20.0545	21.8911	23.7723	(46)

Water storage loss:	
Store volume	180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	212.8882	187.6026	196.9353	176.4162	172.7929	154.2686	148.0366	162.6101	162.3756	182.9395	193.5947	207.7246	(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													
	212.8882	187.6026	196.9353	176.4162	172.7929	154.2686	148.0366	162.6101	162.3756	182.9395	193.5947	207.7246	(64)
								Total per year (kWh/year) = Sum(64)m =				2158.1848	(64)
Heat gains from water heating, kWh/month													
	93.8063	83.1710	88.5019	80.9367	80.4746	73.5727	72.2431	77.0888	76.2682	83.8483	86.6486	92.0894	(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	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	139.1957	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9088	23.0120	18.7146	14.1682	10.5909	8.9413	9.6613	12.5582	16.8556	21.4020	24.9793	26.6289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	264.7132	267.4601	260.5380	245.8017	227.1998	209.7166	198.0367	195.2898	202.2119	216.9482	235.5501	253.0333	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	36.9196	(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)													
	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	-111.3566	(71)
Water heating gains (Table 5)													
	126.0837	123.7664	118.9542	112.4121	108.1647	102.1842	97.1010	103.6140	105.9281	112.6994	120.3452	123.7760	(72)
Total internal gains													
	484.4644	481.9971	465.9655	440.1407	413.7141	388.6008	372.5577	379.2207	392.7543	418.8083	448.6334	471.1970	(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	3.2400	19.6403	0.6300	0.7000	0.7700	19.4475	(76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554	(78)
West	1.6200	19.6403	0.6300	0.7000	0.7700	9.7238	(80)
West	2.5100	26.6072	0.6300	0.7000	1.0000	26.5066	(82)

Solar gains	132.8333	237.0146	347.5341	460.8848	537.5777	541.4028	518.8841	461.5986	387.3624	268.7312	161.1902	112.2578	(83)
Total gains	617.2977	719.0117	813.4996	901.0255	951.2918	930.0035	891.4419	840.8193	780.1167	687.5394	609.8236	583.4548	(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	57.3563	57.5006	57.6427	58.3198	58.4483	59.0538	59.0538	59.1673	58.8191	58.4483	58.1890	57.9204	
alpha	4.8238	4.8334	4.8428	4.8880	4.8966	4.9369	4.9369	4.9445	4.9213	4.8966	4.8793	4.8614	
util living area													
	0.9982	0.9959	0.9892	0.9667	0.9023	0.7592	0.5894	0.6414	0.8682	0.9788	0.9962	0.9986	(86)
MIT	19.6651	19.8245	20.0858	20.4275	20.7292	20.9229	20.9825	20.9738	20.8395	20.4433	19.9915	19.6398	(87)
Th 2	19.9114	19.9138	19.9162	19.9274	19.9295	19.9393	19.9393	19.9411	19.9355	19.9295	19.9253	19.9208	(88)
util rest of house													
	0.9976	0.9944	0.9852	0.9534	0.8617	0.6673	0.4584	0.5107	0.7998	0.9679	0.9946	0.9982	(89)
MIT 2	18.1350	18.3694	18.7509	19.2478	19.6566	19.8861	19.9327	19.9300	19.8032	19.2781	18.6220	18.1047	(90)
Living area fraction										fLA = Living area / (4) =		0.1875	(91)
MIT	18.4218	18.6421	19.0011	19.4689	19.8577	20.0804	20.1295	20.1257	19.9975	19.4965	18.8787	18.3924	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4218	18.6421	19.0011	19.4689	19.8577	20.0804	20.1295	20.1257	19.9975	19.4965	18.8787	18.3924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9919	0.9804	0.9460	0.8584	0.6808	0.4830	0.5349	0.8046	0.9617	0.9922	0.9971	(94)
Useful gains	614.9778	713.2085	797.5841	852.3307	816.6277	633.1445	430.5805	449.7778	627.6704	661.2073	605.0722	581.7738	(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													
	1801.4567	1748.6202	1586.7869	1325.9508	1021.1961	679.0154	437.2976	460.7208	733.6002	1113.6784	1481.0538	1792.8268	(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													
	882.7402	695.7966	587.1669	341.0065	152.1989	0.0000	0.0000	0.0000	0.0000	336.6385	630.7068	901.0235	(98)
Space heating												4527.2778	(98)
Space heating per m2											(98) / (4) =	42.9696	(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	4842.0084	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	882.7402	695.7966	587.1669	341.0065	152.1989	0.0000	0.0000	0.0000	0.0000	336.6385	630.7068	901.0235	(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)													
	944.1072	744.1675	627.9860	364.7128	162.7796	0.0000	0.0000	0.0000	0.0000	360.0411	674.5527	963.6615	(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													
	212.8882	187.6026	196.9353	176.4162	172.7929	154.2686	148.0366	162.6101	162.3756	182.9395	193.5947	207.7246	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.2020	87.9944	87.5515	86.5435	84.4775	79.8000	79.8000	79.8000	79.8000	86.4201	87.7371	88.2823	(217)
Fuel for water heating, kWh/month													
	241.3643	213.1985	224.9364	203.8468	204.5430	193.3191	185.5095	203.7721	203.4782	211.6863	220.6533	235.2959	(219)
Water heating fuel used												2541.6034	(219)
Annual totals kWh/year													
Space heating fuel - main system												4842.0084	(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)												457.5577	(232)
Total delivered energy for all uses												7916.1695	(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	4842.0084	0.2160	1045.8738	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2541.6034	0.2160	548.9863	(264)
Space and water heating			1594.8601	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.5577	0.5190	237.4725	(268)
Total CO2, kg/m2/year			1871.2576	(272)
Emissions per m2 for space and water heating			15.1372	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2539	(272b)
Emissions per m2 for pumps and fans			0.3694	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1372 * 1.55) + 2.2539 + 0.3694, rounded to 2 d.p.			26.0900	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-14	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Top
Property	Plot 14, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	84 B	**DER**	12.54	**TER**	24.41
Environmental	88 B	**% DER<TER**	48.63		
CO_2 Emissions (t/year)	1.57	**DFEE**	45.84	**TFEE**	56.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	18.20		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	142.8100 (1b)	x	2.5800 (2b)	=	368.4498	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	142.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.4498	(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) =	0.1086	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3586	(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) =	0.3048	(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	0.3886	0.3810	0.3734	0.3353	0.3276	0.2895	0.2895	0.2819	0.3048	0.3276	0.3429	0.3581	(22b)
Effective ac	0.5755	0.5726	0.5697	0.5562	0.5537	0.5419	0.5419	0.5397	0.5464	0.5537	0.5588	0.5641	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			4.8600	1.3258	6.4432			(27)
Velux (Uw = 1.40)			2.5100	1.3258	3.3277			(27a)
Dwarf	53.5100	4.8600	48.6500	0.1300	6.3245	9.0000	437.8500	(29a)
Corridor	18.2700	1.7200	16.5500	0.2257	3.7359	110.0000	1820.5000	(29a)
Fl	81.0400		81.0400	0.1300	10.5352	9.0000	729.3600	(30)
PIR	85.2100	2.5100	82.7000	0.1300	10.7510	9.0000	744.3000	(30)
Total net area of external elements Aum(A, m2)			238.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.1814			(33)
Party Wall 1			41.2500	0.0000	0.0000	20.0000	825.0000	(32)
Party Floor 1			142.8100			40.0000	5712.4000	(32d)
Internal Wall 1			195.9800			9.0000	1763.8200	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.2300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		84.2604 (35)
Thermal bridges (User defined value 0.150 * total exposed area)		35.7045 (36)
Total fabric heat loss	(33) + (36) =	78.8859 (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	69.9744	69.6179	69.2685	67.6273	67.3202	65.8908	65.8908	65.6261	66.4414	67.3202	67.9414	68.5908	(38)
Heat transfer coeff	148.8603	148.5038	148.1544	146.5132	146.2062	144.7767	144.7767	144.5120	145.3273	146.2062	146.8273	147.4768	(39)
Average = Sum(39)m / 12 =												146.5117	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0424	1.0399	1.0374	1.0259	1.0238	1.0138	1.0138	1.0119	1.0176	1.0238	1.0281	1.0327	(40)
HLP (average)												1.0259	(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		2.9223 (42)
Average daily hot water use (litres/day)		103.6035 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.9638	109.8197	105.6756	101.5314	97.3873	93.2431	93.2431	97.3873	101.5314	105.6756	109.8197	113.9638	(44)
Energy conte	169.0051	147.8129	152.5297	132.9791	127.5966	110.1062	102.0296	117.0804	118.4787	138.0755	150.7202	163.6724	(45)
Energy content (annual)										Total = Sum(45)m =		1630.0864	(45)
Distribution loss (46)m = 0.15 x (45)m													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	25.3508	22.1719	22.8795	19.9469	19.1395	16.5159	15.3044	17.5621	17.7718	20.7113	22.6080	24.5509	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	214.5875	188.9841	198.1121	177.0911	173.1790	154.2182	147.6120	162.6628	162.5907	183.6579	194.8322	209.2548	(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													
	214.5875	188.9841	198.1121	177.0911	173.1790	154.2182	147.6120	162.6628	162.5907	183.6579	194.8322	209.2548	(64)
								Total per year (kWh/year) = Sum(64)m =				2166.7824	(64)
Heat gains from water heating, kWh/month													
	92.6601	82.0848	87.1820	79.5051	78.8918	71.8999	70.3907	75.3952	74.6838	82.3760	85.4041	90.8870	(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	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.7421	31.7458	25.8174	19.5455	14.6105	12.3348	13.3281	17.3244	23.2528	29.5248	34.4598	36.7355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	312.5849	315.8286	307.6547	290.2534	268.2874	247.6425	233.8504	230.6068	238.7807	256.1819	278.1479	298.7928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	(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)													
	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	(71)
Water heating gains (Table 5)													
	124.5432	122.1499	117.1802	110.4238	106.0374	99.8610	94.6112	101.3376	103.7275	110.7205	118.6168	122.1599	(72)
Total internal gains													
	539.7040	536.5581	517.4861	487.0565	455.7690	426.6720	408.6236	416.1026	432.5947	463.2610	498.0583	524.5221	(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	4.8600	10.6334	0.6300	0.7000	0.7700	15.7936	(74)
North	1.8800	15.6897	0.7400	0.7000	1.0000	13.7513	(82)
West	0.6300	26.2379	0.7400	0.7000	1.0000	7.7062	(82)

Solar gains	37.2511	71.4445	124.0043	205.8520	284.1598	307.2624	285.6475	222.3313	151.0230	85.5542	45.9520	31.0821	(83)
Total gains	576.9551	608.0026	641.4903	692.9085	739.9288	733.9344	694.2710	638.4338	583.6178	548.8152	544.0102	555.6042	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.4544	22.5083	22.5613	22.8141	22.8620	23.0877	23.0877	23.1300	23.0002	22.8620	22.7653	22.6650	
alpha	2.4970	2.5006	2.5041	2.5209	2.5241	2.5392	2.5392	2.5420	2.5333	2.5241	2.5177	2.5110	
util living area													
	0.9799	0.9755	0.9655	0.9408	0.8889	0.7952	0.6859	0.7320	0.8755	0.9498	0.9735	0.9817	(86)
MIT	18.2320	18.4064	18.7922	19.3738	19.9807	20.5000	20.7656	20.7120	20.2842	19.5491	18.8094	18.2045	(87)
Th 2	20.0482	20.0502	20.0523	20.0618	20.0636	20.0719	20.0719	20.0734	20.0687	20.0636	20.0600	20.0562	(88)
util rest of house													
	0.9771	0.9720	0.9602	0.9305	0.8661	0.7443	0.5948	0.6488	0.8409	0.9392	0.9691	0.9792	(89)
MIT 2	16.2897	16.5451	17.1084	17.9569	18.8259	19.5467	19.8803	19.8242	19.2657	18.2172	17.1395	16.2538	(90)
Living area fraction									fLA = Living area / (4) =			0.2591	(91)
MIT	16.7929	17.0273	17.5446	18.3240	19.1251	19.7937	20.1097	20.0542	19.5295	18.5623	17.5721	16.7592	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7929	17.0273	17.5446	18.3240	19.1251	19.7937	20.1097	20.0542	19.5295	18.5623	17.5721	16.7592	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9623	0.9552	0.9394	0.9039	0.8367	0.7261	0.5990	0.6468	0.8150	0.9148	0.9515	0.9655	(94)
Useful gains	555.1807	580.7388	602.6438	626.3339	619.1051	532.8969	415.8962	412.9447	475.6441	502.0397	517.6297	536.4082	(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													
	1859.6950	1800.9530	1636.3111	1380.7423	1085.5945	751.9284	508.1235	528.0789	789.0595	1164.1367	1537.5958	1852.1926	(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													
	970.5586	819.9840	769.0484	543.1740	347.0682	0.0000	0.0000	0.0000	0.0000	492.6001	734.3755	978.9436	(98)
Space heating												5655.7525	(98)
Space heating per m2										(98) / (4) =		39.6033	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	5655.7525	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	5938.5401	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2166.7824	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2275.1215	(310a)
Electricity used for heat distribution	82.1366	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	631.2167	(332)
Total delivered energy for all uses	8844.8783	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2737.8872	0.5190	1420.9635	(367)
Electrical energy for heat distribution	82.1366	0.5190	42.6289	(372)
Total CO2 associated with community systems			1463.5924	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1463.5924	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	631.2167	0.5190	327.6015	(379)
Total CO2, kg/year			1791.1938	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5400	(384)

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

DER		12.5400	ZC1
Total Floor Area	TFA	142.8100	
Assumed number of occupants	N	2.9223	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.9705	ZC2
CO2 emissions from cooking, equation (L16)		1.3244	ZC3
Total CO2 emissions		26.8348	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		26.8348	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	142.8100 (1b)	x	2.5800 (2b)	=	368.4498	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	142.8100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	368.4498	(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) =	0.1086	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3586	(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) =	0.3048	(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	0.3886	0.3810	0.3734	0.3353	0.3276	0.2895	0.2895	0.2819	0.3048	0.3276	0.3429	0.3581	(22b)
Effective ac	0.5755	0.5726	0.5697	0.5562	0.5537	0.5419	0.5419	0.5397	0.5464	0.5537	0.5588	0.5641	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			4.8600	1.3258	6.4432			(27)
TER Room Window (Uw = 1.70)			2.5100	1.5918	3.9953			(27a)
Dwarf	53.5100	4.8600	48.6500	0.1800	8.7570			(29a)
Corridor	18.2700	1.7200	16.5500	0.1800	2.9790			(29a)
Fl	81.0400		81.0400	0.1300	10.5352			(30)
PIR	85.2100	2.5100	82.7000	0.1300	10.7510			(30)
Total net area of external elements Aum(A, m2)			238.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.1807			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.7638	(36)
Total fabric heat loss (33) + (36) =	72.9445	(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	69.9744	69.6179	69.2685	67.6273	67.3202	65.8908	65.8908	65.6261	66.4414	67.3202	67.9414	68.5908	(38)
Heat transfer coeff	142.9189	142.5624	142.2130	140.5718	140.2647	138.8353	138.8353	138.5706	139.3859	140.2647	140.8859	141.5353	(39)
Average = Sum(39)m / 12 =												140.5703	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0008	0.9983	0.9958	0.9843	0.9822	0.9722	0.9722	0.9703	0.9760	0.9822	0.9865	0.9911	(40)
HLP (average)												0.9843	(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	2.9223 (42)
Average daily hot water use (litres/day)	103.6035 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.9638	109.8197	105.6756	101.5314	97.3873	93.2431	93.2431	97.3873	101.5314	105.6756	109.8197	113.9638	(44)
Energy conte	169.0051	147.8129	152.5297	132.9791	127.5966	110.1062	102.0296	117.0804	118.4787	138.0755	150.7202	163.6724	(45)
Energy content (annual)										Total = Sum(45)m =		1630.0864	(45)
Distribution loss (46)m = 0.15 x (45)m	25.3508	22.1719	22.8795	19.9469	19.1395	16.5159	15.3044	17.5621	17.7718	20.7113	22.6080	24.5509	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	218.2478	192.2902	201.7724	180.6333	176.8393	157.7604	151.2722	166.3231	166.1329	187.3182	198.3744	212.9151	(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													
	218.2478	192.2902	201.7724	180.6333	176.8393	157.7604	151.2722	166.3231	166.1329	187.3182	198.3744	212.9151	(64)
								Total per year (kWh/year) = Sum(64)m =				2209.8791	(64)
Heat gains from water heating, kWh/month													
	95.5883	84.7296	90.1103	82.3389	81.8200	74.7337	73.3190	78.3234	77.5175	85.3042	88.2378	93.8152	(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	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	146.1126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.7421	31.7458	25.8174	19.5455	14.6105	12.3348	13.3281	17.3244	23.2528	29.5248	34.4598	36.7355	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	312.5849	315.8286	307.6547	290.2534	268.2874	247.6425	233.8504	230.6068	238.7807	256.1819	278.1479	298.7928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	37.6113	(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)													
	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	-116.8901	(71)
Water heating gains (Table 5)													
	128.4789	126.0857	121.1159	114.3596	109.9731	103.7967	98.5470	105.2733	107.6632	114.6562	122.5525	126.0957	(72)
Total internal gains													
	546.6397	543.4939	524.4218	493.9922	462.7048	433.6078	415.5594	423.0383	439.5305	470.1968	504.9940	531.4578	(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	4.8600	10.6334	0.6300	0.7000	0.7700	15.7936	(74)
North	1.8800	15.6897	0.6300	0.7000	1.0000	11.7072	(82)
West	0.6300	26.2379	0.6300	0.7000	1.0000	6.5607	(82)

Solar gains	34.0615	65.3109	113.1950	187.4981	258.4159	279.2478	259.6738	202.3627	137.7399	78.1773	42.0174	28.4189	(83)
Total gains	580.7012	608.8048	637.6168	681.4903	721.1207	712.8556	675.2332	625.4011	577.2704	548.3741	547.0115	559.8768	(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	69.3915	69.5650	69.7360	70.5501	70.7046	71.4326	71.4326	71.5690	71.1504	70.7046	70.3928	70.0699	
alpha	5.6261	5.6377	5.6491	5.7033	5.7136	5.7622	5.7622	5.7713	5.7434	5.7136	5.6929	5.6713	
util living area													
	0.9997	0.9996	0.9991	0.9967	0.9846	0.9283	0.8063	0.8603	0.9780	0.9977	0.9995	0.9998	(86)
MIT	19.7790	19.8592	20.0358	20.3072	20.5967	20.8458	20.9548	20.9324	20.7302	20.3816	20.0432	19.7688	(87)
Th 2	20.0827	20.0848	20.0868	20.0964	20.0982	20.1066	20.1066	20.1081	20.1034	20.0982	20.0946	20.0908	(88)
util rest of house													
	0.9996	0.9994	0.9987	0.9952	0.9756	0.8802	0.6867	0.7575	0.9600	0.9963	0.9993	0.9997	(89)
MIT 2	18.4241	18.5431	18.8030	19.2069	19.6268	19.9702	20.0835	20.0682	19.8222	19.3174	18.8197	18.4151	(90)
Living area fraction										fLA = Living area / (4) =		0.2591	(91)
MIT	18.7751	18.8841	19.1224	19.4919	19.8781	20.1970	20.3093	20.2921	20.0575	19.5931	19.1367	18.7658	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7751	18.8841	19.1224	19.4919	19.8781	20.1970	20.3093	20.2921	20.0575	19.5931	19.1367	18.7658	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9991	0.9981	0.9937	0.9726	0.8862	0.7174	0.7826	0.9587	0.9951	0.9989	0.9996	(94)
Useful gains	580.3726	608.2775	636.4282	677.1830	701.3670	631.7603	484.4364	489.4458	553.4113	545.7080	546.4203	559.6256	(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													
	2068.7722	1993.6104	1795.0709	1488.9285	1147.1009	777.0670	514.9790	539.3341	830.3883	1261.4109	1695.8055	2061.5738	(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													
	1107.3693	930.9437	862.0302	584.4568	331.6260	0.0000	0.0000	0.0000	0.0000	532.4830	827.5574	1117.4495	(98)
Space heating												6293.9157	(98)
Space heating per m2											(98) / (4) =	44.0720	(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												6731.4607	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1107.3693	930.9437	862.0302	584.4568	331.6260	0.0000	0.0000	0.0000	0.0000	532.4830	827.5574	1117.4495	(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)													
	1184.3522	995.6617	921.9574	625.0875	354.6802	0.0000	0.0000	0.0000	0.0000	569.5005	885.0881	1195.1331	(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													
	218.2478	192.2902	201.7724	180.6333	176.8393	157.7604	151.2722	166.3231	166.1329	187.3182	198.3744	212.9151	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5453	88.4692	88.2555	87.7230	86.4677	79.8000	79.8000	79.8000	79.8000	87.4486	88.2129	88.5987	(217)
Fuel for water heating, kWh/month													
	246.4814	217.3526	228.6231	205.9133	204.5148	197.6947	189.5642	208.4249	208.1866	214.2038	224.8814	240.3139	(219)
Water heating fuel used												2586.1547	(219)
Annual totals kWh/year													
Space heating fuel - main system												6731.4607	(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)												631.2167	(232)
Total delivered energy for all uses												10023.8321	(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	6731.4607	0.2160	1453.9955	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2586.1547	0.2160	558.6094	(264)
Space and water heating			2012.6049	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	631.2167	0.5190	327.6015	(268)
Total CO2, kg/m2/year			2379.1314	(272)
Emissions per m2 for space and water heating			14.0929	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2940	(272b)
Emissions per m2 for pumps and fans			0.2726	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0929 * 1.55) + 2.2940 + 0.2726, rounded to 2 d.p.			24.4100	(273)

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

Anderson Goddard Ltd
Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

Property Reference	75009-15	**Issued on Date**	21/09/2021
Assessment Reference	001	**Prop Type Ref**	HT Top
Property	Plot 15, Green Lane, NORTHWOOD, HA6 2UZ		

SAP Rating	84 B	**DER**	12.41	**TER**	23.74
Environmental	88 B	**% DER<TER**	47.73		
CO_2 Emissions (t/year)	1.64	**DFEE**	47.21	**TFEE**	55.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.37		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 01925 733942, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client	Bluesky, Ivan Ball		

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	150.7800 (1b)	x	2.6400 (2b)	=	398.0592	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	398.0592	(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) =	0.1256	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3756	(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) =	0.3193	(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	0.4071	0.3991	0.3911	0.3512	0.3432	0.3033	0.3033	0.2953	0.3193	0.3432	0.3592	0.3751	(22b)
Effective ac	0.5829	0.5796	0.5765	0.5617	0.5589	0.5460	0.5460	0.5436	0.5510	0.5589	0.5645	0.5704	(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			1.7200	1.2000	2.0640			(26)
Window (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
Velux (Uw = 1.40)			3.1400	1.3258	4.1629			(27a)
Dwarf	62.9700	10.2600	52.7100	0.1300	6.8523	9.0000	474.3900	(29a)
Corridor	21.4700	1.7200	19.7500	0.2257	4.4582	110.0000	2172.5000	(29a)
Fl	79.5700		79.5700	0.1300	10.3441	9.0000	716.1300	(30)
PIR	98.2600	3.1400	95.1200	0.1300	12.3656	9.0000	856.0800	(30)
Total net area of external elements Aum(A, m2)			262.2700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.8494			(33)
Party Wall 1			25.9100	0.0000	0.0000	20.0000	518.2000	(32)
Party Floor 1			150.7800			40.0000	6031.2000	(32d)
Internal Wall 1			247.2700			9.0000	2225.4300	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		12993.9300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							86.1781	(35)
Thermal bridges (User defined value 0.150 * total exposed area)							39.3405	(36)
Total fabric heat loss					(33) + (36) =		93.1899	(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	76.5631	76.1405	75.7263	73.7806	73.4165	71.7219	71.7219	71.4081	72.3746	73.4165	74.1530	74.9229	(38)
Heat transfer coeff	169.7530	169.3304	168.9162	166.9705	166.6064	164.9118	164.9118	164.5980	165.5645	166.6064	167.3429	168.1128	(39)
Average = Sum(39)m / 12 =												166.9687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1258	1.1230	1.1203	1.1074	1.1050	1.0937	1.0937	1.0916	1.0981	1.1050	1.1098	1.1150	(40)
HLP (average)												1.1074	(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												2.9354	(42)
Average daily hot water use (litres/day)												103.9157	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3073	110.1507	105.9940	101.8374	97.6808	93.5242	93.5242	97.6808	101.8374	105.9940	110.1507	114.3073	(44)
Energy conte	169.5144	148.2584	152.9894	133.3799	127.9811	110.4380	102.3370	117.4332	118.8358	138.4916	151.1744	164.1657	(45)
Energy content (annual)										Total = Sum(45)m =		1634.9990	(45)
Distribution loss (46)m = 0.15 x (45)m													

	25.4272	22.2388	22.9484	20.0070	19.1972	16.5657	15.3506	17.6150	17.8254	20.7737	22.6762	24.6248	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.7200	(55)
Total storage loss													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage													
	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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													
	215.0968	189.4296	198.5718	177.4919	173.5635	154.5500	147.9194	163.0156	162.9478	184.0740	195.2864	209.7481	(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													
	215.0968	189.4296	198.5718	177.4919	173.5635	154.5500	147.9194	163.0156	162.9478	184.0740	195.2864	209.7481	(64)
								Total per year (kWh/year) = Sum(64)m =				2171.6950	(64)
Heat gains from water heating, kWh/month													
	92.8295	82.2329	87.3349	79.6384	79.0196	72.0102	70.4930	75.5125	74.8025	82.5144	85.5551	91.0510	(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	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	146.7699	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.5736	29.8198	24.2511	18.3596	13.7240	11.5864	12.5195	16.2733	21.8421	27.7335	32.3691	34.5067	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	321.3698	324.7046	316.3009	298.4106	275.8273	254.6022	240.4225	237.0877	245.4913	263.3816	285.9649	307.1901	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	37.6770	(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)													
	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	-117.4160	(71)
Water heating gains (Table 5)													
	124.7708	122.3704	117.3856	110.6089	106.2092	100.0142	94.7486	101.4953	103.8924	110.9064	118.8265	122.3804	(72)
Total internal gains													
	546.7451	543.9257	524.9686	494.4101	462.7916	433.2338	414.7217	421.8873	438.2567	469.0526	504.1916	531.1081	(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	7.0200	10.6334	0.6300	0.7000	0.7700	22.8129	(74)
South	3.2400	46.7521	0.6300	0.7000	0.7700	46.2932	(78)
East	3.1400	26.2379	0.7400	0.7000	1.0000	38.4089	(82)

Solar gains	107.5151	196.5108	302.6148	428.5993	526.9263	543.1655	515.3672	439.3175	346.0147	226.4555	131.2567	90.3834	(83)
Total gains	654.2602	740.4364	827.5834	923.0095	989.7179	976.3993	930.0889	861.2048	784.2714	695.5080	635.4483	621.4915	(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	21.2628	21.3159	21.3681	21.6171	21.6644	21.8870	21.8870	21.9287	21.8007	21.6644	21.5690	21.4703	
alpha	2.4175	2.4211	2.4245	2.4411	2.4443	2.4591	2.4591	2.4619	2.4534	2.4443	2.4379	2.4314	
util living area													
	0.9776	0.9686	0.9511	0.9140	0.8464	0.7380	0.6185	0.6641	0.8287	0.9328	0.9689	0.9802	(86)
MIT	18.1369	18.3769	18.8275	19.4543	20.0643	20.5579	20.8015	20.7552	20.3508	19.5749	18.7556	18.0989	(87)
Th 2	19.9798	19.9821	19.9843	19.9948	19.9968	20.0060	20.0060	20.0077	20.0024	19.9968	19.9928	19.9886	(88)
util rest of house													
	0.9744	0.9640	0.9436	0.8992	0.8164	0.6779	0.5200	0.5711	0.7837	0.9185	0.9636	0.9774	(89)
MIT 2	16.1131	16.4633	17.1189	18.0277	18.8909	19.5620	19.8551	19.8103	19.3024	18.2123	17.0230	16.0624	(90)
Living area fraction									fLA = Living area / (4) =			0.2583	(91)
MIT	16.6359	16.9577	17.5603	18.3962	19.1940	19.8192	20.0996	20.0544	19.5732	18.5643	17.4705	16.5885	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6359	16.9577	17.5603	18.3962	19.1940	19.8192	20.0996	20.0544	19.5732	18.5643	17.4705	16.5885	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9579	0.9436	0.9176	0.8679	0.7867	0.6649	0.5304	0.5761	0.7597	0.8900	0.9435	0.9623	(94)
Useful gains	626.7262	698.6445	759.3675	801.1221	778.5861	649.1696	493.3058	496.1136	595.8455	618.9971	599.5337	598.0752	(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													
	2094.0531	2041.7286	1868.2555	1585.5912	1248.5526	860.7117	577.1254	601.5031	906.1658	1326.9042	1735.4374	2082.6583	(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													
	1091.6912	902.5525	825.0127	564.8177	349.6551	0.0000	0.0000	0.0000	0.0000	526.6829	817.8507	1104.5298	(98)
Space heating												6182.7925	(98)
Space heating per m2											(98) / (4) =	41.0054	(99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	6182.7925	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	6491.9321	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	2171.6950	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	2280.2797	(310a)
Electricity used for heat distribution	87.7221	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(331)
Electricity for lighting (calculated in Appendix L)	592.9203	(332)
Total delivered energy for all uses	9365.1322	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			300.0000	(367a)
Space heating from Heat pump	2924.0706	0.5190	1517.5926	(367)
Electrical energy for heat distribution	87.7221	0.5190	45.5278	(372)
Total CO2 associated with community systems			1563.1204	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			1563.1204	(376)
Pumps and fans	0.0000	0.0000	0.0000	(378)
Energy for lighting	592.9203	0.5190	307.7257	(379)
Total CO2, kg/year			1870.8461	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			12.4100	(384)

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

DER		12.4100	ZC1
Total Floor Area	TFA	150.7800	
Assumed number of occupants	N	2.9354	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.6301	ZC2
CO2 emissions from cooking, equation (L16)		1.2565	ZC3
Total CO2 emissions		26.2966	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		26.2966	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	150.7800 (1b)	x	2.6400 (2b)	=	398.0592	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	150.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	398.0592	(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) =	0.1005	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3505	(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) =	0.2979	(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	0.3798	0.3724	0.3649	0.3277	0.3203	0.2830	0.2830	0.2756	0.2979	0.3203	0.3352	0.3500	(22b)
Effective ac	0.5721	0.5693	0.5666	0.5537	0.5513	0.5400	0.5400	0.5380	0.5444	0.5513	0.5562	0.5613	(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			1.7200	1.0000	1.7200			(26)
TER Opening Type (Uw = 1.40)			10.2600	1.3258	13.6023			(27)
TER Room Window (Uw = 1.70)			3.1400	1.5918	4.9981			(27a)
Dwarf	62.9700	10.2600	52.7100	0.1800	9.4878			(29a)
Corridor	21.4700	1.7200	19.7500	0.1800	3.5550			(29a)
Fl	79.5700		79.5700	0.1300	10.3441			(30)
PIR	98.2600	3.1400	95.1200	0.1300	12.3656			(30)
Total net area of external elements Aum(A, m2)			262.2700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0729			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.7638	(36)
Total fabric heat loss (33) + (36) =	83.8367	(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	75.1560	74.7880	74.4273	72.7332	72.4162	70.9407	70.9407	70.6674	71.5090	72.4162	73.0574	73.7278	(38)
Heat transfer coeff	158.9927	158.6247	158.2640	156.5699	156.2529	154.7774	154.7774	154.5041	155.3457	156.2529	156.8941	157.5645	(39)
Average = Sum(39)m / 12 =												156.5684	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0545	1.0520	1.0496	1.0384	1.0363	1.0265	1.0265	1.0247	1.0303	1.0363	1.0406	1.0450	(40)
HLP (average)												1.0384	(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	2.9354 (42)
Average daily hot water use (litres/day)	103.9157 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.3073	110.1507	105.9940	101.8374	97.6808	93.5242	93.5242	97.6808	101.8374	105.9940	110.1507	114.3073	(44)
Energy conte	169.5144	148.2584	152.9894	133.3799	127.9811	110.4380	102.3370	117.4332	118.8358	138.4916	151.1744	164.1657	(45)
Energy content (annual)										Total = Sum(45)m =		1634.9990	(45)
Distribution loss (46)m = 0.15 x (45)m	25.4272	22.2388	22.9484	20.0070	19.1972	16.5657	15.3506	17.6150	17.8254	20.7737	22.6762	24.6248	(46)

Water storage loss:	
Store volume	180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520 (48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.8381 (55)
Total storage loss
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (56)
If cylinder contains dedicated solar storage
              25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (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
             218.7571   192.7356   202.2321   181.0340   177.2238   158.0922   151.5797   166.6759   166.4900   187.7343   198.8286   213.4083 (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
             218.7571   192.7356   202.2321   181.0340   177.2238   158.0922   151.5797   166.6759   166.4900   187.7343   198.8286   213.4083 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   2214.7917 (64)
Heat gains from water heating, kWh/month
              95.7577    84.8777    90.2631    82.4722    81.9479    74.8440    73.4212    78.4407    77.6363    85.4426    88.3889    93.9792 (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       146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699   146.7699 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              33.5736    29.8198    24.2511    18.3596    13.7240    11.5864    12.5195    16.2733    21.8421    27.7335    32.3691    34.5067 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             321.3698   324.7046   316.3009   298.4106   275.8273   254.6022   240.4225   237.0877   245.4913   263.3816   285.9649   307.1901 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770    37.6770 (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)
            -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160  -117.4160 (71)
Water heating gains (Table 5)
             128.7066   126.3061   121.3214   114.5447   110.1450   103.9500    98.6844   105.4310   107.8281   114.8422   122.7623   126.3162 (72)
Total internal gains
             553.6809   550.8615   531.9044   501.3459   469.7273   440.1696   421.6574   428.8231   445.1925   475.9883   511.1273   538.0439 (73)
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6. Solar gains

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[Jan]                                    Area          Solar flux              g                FF            Access              Gains
                                          m2           Table 6a       Specific data    Specific data        factor                 W
                                                          W/m2         or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------------------------------
North                                  7.0200            10.6334            0.6300           0.7000            0.7700           22.8129 (74)
South                                  3.2400            46.7521            0.6300           0.7000            0.7700           46.2932 (78)
East                                   3.1400            26.2379            0.6300           0.7000            1.0000           32.6995 (82)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains   101.8056   185.0503   282.9996   398.8023   489.3350   504.2045   478.4720   408.3473   322.8167   212.6632   124.0858    85.7212 (83)
Total gains   655.4865   735.9117   814.9040   900.1482   959.0623   944.3741   900.1295   837.1704   768.0092   688.6516   635.2131   623.7651 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          65.8573    66.0101    66.1605    66.8764    67.0121    67.6509    67.6509    67.7706    67.4034    67.0121    66.7382    66.4543
alpha         5.3905     5.4007     5.4107     5.4584     5.4675     5.5101     5.5101     5.5180     5.4936     5.4675     5.4492     5.4303
util living area
              0.9996     0.9991     0.9976     0.9909     0.9624     0.8659     0.7093     0.7698     0.9487     0.9947     0.9991     0.9997 (86)

MIT          19.7322    19.8467    20.0598    20.3626    20.6628    20.8898    20.9729    20.9577    20.7814    20.4021    20.0174    19.7150 (87)
Th 2         20.0382    20.0402    20.0422    20.0515    20.0532    20.0613    20.0613    20.0628    20.0582    20.0532    20.0497    20.0460 (88)
util rest of house
              0.9995     0.9988     0.9967     0.9868     0.9431     0.7959     0.5809     0.6486     0.9130     0.9917     0.9988     0.9996 (89)
MIT 2        18.3233    18.4922    18.8053    19.2527    19.6799    19.9739    20.0493    20.0414    19.8489    19.3134    18.7490    18.3037 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.2583 (91)
MIT          18.6872    18.8421    19.1294    19.5394    19.9338    20.2105    20.2879    20.2781    20.0898    19.5946    19.0767    18.6683 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT 18.6872    18.8421    19.1294    19.5394    19.9338    20.2105    20.2879    20.2781    20.0898    19.5946    19.0767    18.6683 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation   0.9992     0.9982     0.9954     0.9837     0.9399     0.8088     0.6142     0.6795     0.9146     0.9896     0.9982     0.9994 (94)
Useful gains 654.9317   734.6216   811.1308   885.4977   901.4596   763.7883   552.9021   568.8547   702.4149   681.4733   634.0717   623.3671 (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
            2287.4637  2211.5621  1998.7727  1665.8157  1286.5504   868.3769   570.7992   599.1855   930.4938  1405.4373  1879.0691  2279.6940 (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
            1214.6038   992.5040   883.6056   561.8289   286.5076     0.0000     0.0000     0.0000     0.0000   538.6292   896.3981  1232.3072 (98)
Space heating                                                                                                    6606.3845 (98)
Space heating per m2                                                                                  (98) / (4) =     43.8147 (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	7065.6519	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1214.6038	992.5040	883.6056	561.8289	286.5076	0.0000	0.0000	0.0000	0.0000	538.6292	896.3981	1232.3072	(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)													
	1299.0415	1061.5016	945.0327	600.8865	306.4253	0.0000	0.0000	0.0000	0.0000	576.0740	958.7146	1317.9756	(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													
	218.7571	192.7356	202.2321	181.0340	177.2238	158.0922	151.5797	166.6759	166.4900	187.7343	198.8286	213.4083	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.6852	88.5688	88.2950	87.6364	86.0885	79.8000	79.8000	79.8000	79.8000	87.4687	88.3494	88.7435	(217)
Fuel for water heating, kWh/month													
	246.6671	217.6111	229.0413	206.5741	205.8622	198.1105	189.9495	208.8671	208.6340	214.6302	225.0481	240.4777	(219)
Water heating fuel used												2591.4729	(219)
Annual totals kWh/year													
Space heating fuel - main system												7065.6519	(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)												592.9203	(232)
Total delivered energy for all uses												10325.0451	(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	7065.6519	0.2160	1526.1808	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2591.4729	0.2160	559.7581	(264)
Space and water heating			2085.9389	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	592.9203	0.5190	307.7257	(268)
Total CO2, kg/m2/year			2432.5896	(272)
Emissions per m2 for space and water heating			13.8343	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0409	(272b)
Emissions per m2 for pumps and fans			0.2582	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.8343 * 1.55) + 2.0409 + 0.2582, rounded to 2 d.p.			23.7400	(273)

Appendix 4: 'Be Clean' GLA SAP 10 Spreadsheet

Be Clean - SAP 2012 Methodology SAP 10 Carbon Factors

Project	London School of Theology, Northwood (Trinity House)
Client	
Date	Oct-21
Rev	A

SAP 2012	Carbon Factor	SAP 10	Carbon Factor
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

Residential Accommodation

TER

Plot	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps & Fans	Lighting	Emissions
1	3	147.5	GND	6243	2595	75	543	2000.0
2	2	146.2	GND	6453	2592	75	537	2042.0
3	2	135.3	GND	5732	2591	75	503	1882.5
4	3	150.9	MID	5459	2604	75	565	1842.4
5	2	104.8	MID	3089	2561	75	481	1316.0
6	2	114.8	MID	3928	2578	75	459	1490.7
7	2	121.0	GND	4271	2585	75	520	1578.4
8	2	131.2	MID	4744	2597	75	502	1676.1
9	2	144.4	MID	4505	2610	75	562	1642.6
10	2	115.2	MID	3864	2578	75	498	1486.3
11	2	95.6	MID	3896	2512	75	429	1463.1
12	2	96.3	MID	3960	2513	75	455	1482.8
13	2	105.4	TOP	4842	2542	75	458	1674.8
14	2	142.8	TOP	6731	2586	75	631	2121.1
15	2	150.8	TOP	7066	2591	75	593	2183.6
		1902.3						**25882.4**

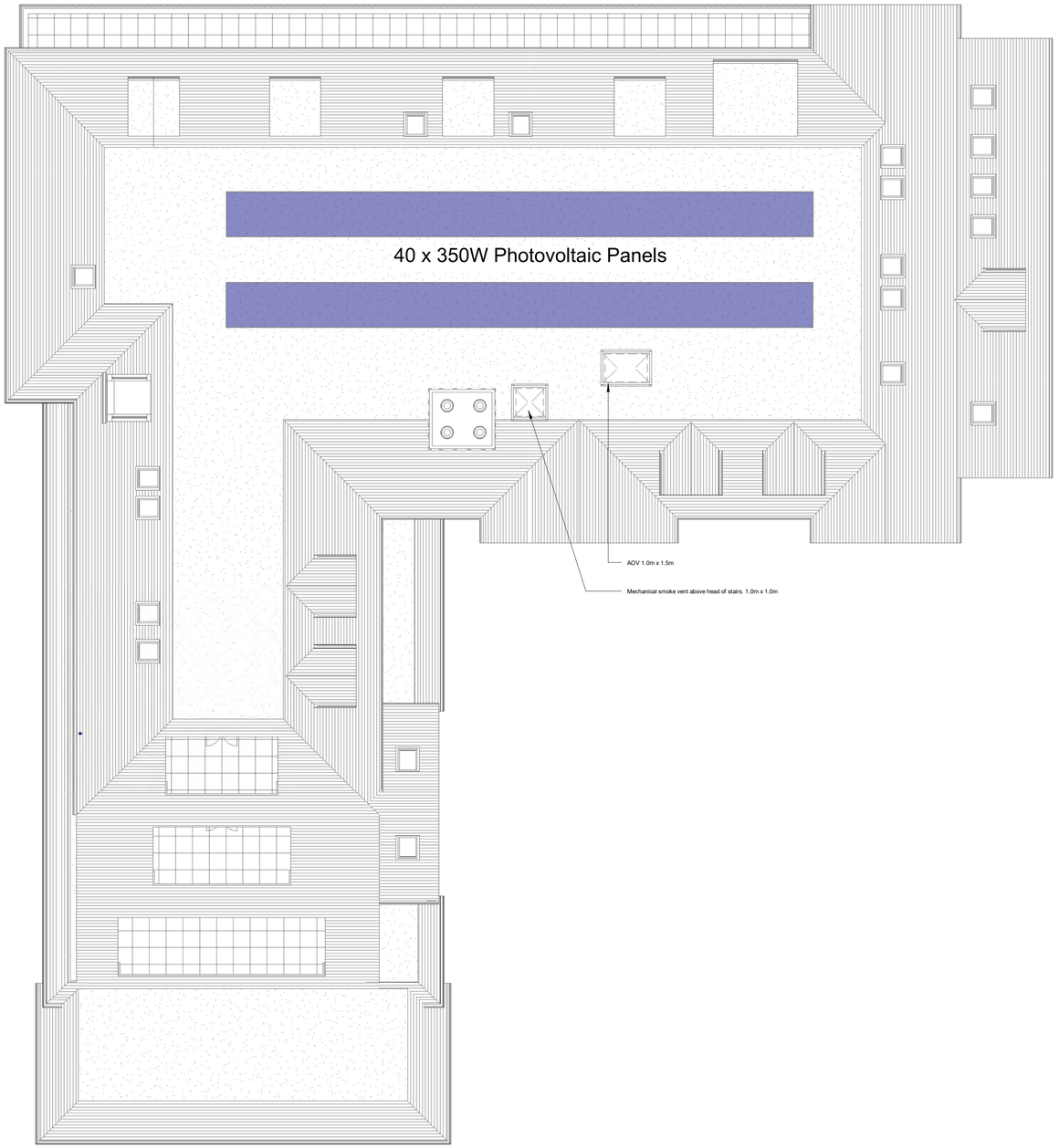
DER - Based on ASHPs with SAP 10 Carbon Factors

Plot	Heating	Distribution	Pumps & Fans	Lighting	Emissions
1	2845	85	0	543	809.2
2	2892	87	0	537	819.2
3	2611	78	0	503	743.7
4	2401	72	0	565	707.9
5	1734	52	0	481	528.2
6	2007	60	0	459	588.6
7	2181	65	0	520	644.5
8	2431	73	0	502	700.4
9	2207	66	0	562	660.6
10	1934	58	0	498	580.2
11	1879	56	0	429	550.8
12	1916	57	0	455	565.7
13	2218	67	0	458	639.1
14	2738	82	0	631	804.1
15	2924	88	0	593	840.0
					10182.1

Total Site Design Emissions (Be Clean) **10,182** $kgCO_2$ per year

Appendix 5 – Roof Plan showing Indicative Location of Photovoltaic Panels

IMPORTANT NOTE:
THIS DRAWING IS INTENDED FOR THE LOCAL AUTHORITY BUILDING CONTROL DEPARTMENT TO HELP ILLUSTRATE COMPLIANCE TO THE BUILDING REGULATIONS. SHOULD THE BUILDER CHOOSE TO FOLLOW THE DRAWING, THEY ARE TO TAKE FULL RESPONSIBILITY FOR THE CONSTRUCTION OF THE BUILDING INCLUDING THE COMPLIANCE TO THE BUILDING REGULATIONS, WORKMANSHIP, LOCATIONS OF STEELS, FINAL DETAILS AND APPEARANCE OF THE BUILDING. DIMENSIONS, LEVELS AND EXISTING CONSTRUCTION MATERIALS ARE TO BE CHECKED ON SITE PRIOR TO THE CONSTUCTION OF THE PROPOSED WORKS BY THE BUILDER.
ALL STRUCTURAL ALTERATIONS TO BE OVERSEEN BY A STRUCTURAL ENGINEER. REFER TO STRUCTURAL ENGINEER S DETAILS FOR STEEL LOCATIONS AND SIZES.



KEY:

- Thermal insulation
- Accoustic insulation
- Brickwork
- Blockwork
- Proposed drains
- Proposed rain water
- Extract run
- Extract run exiting through roof
- Code 5 lead
- DPM/Breahter Membrane
- FD30 — 30min Fire Door
- SA — Smoke Alarm - (Mains Linked)
- HD — Heat detector - (Mains Linked)
- Escape distance

Key
1 : 50

1 **Roof Plan**
1 : 100

Rev	Description	Date

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Trinity House, Northwood

Roof Plan

0 1 2 3 4 5 6 7 8 9 10
GRAPHIC SCALE: 1:100
9975.32 mm

Scale @ A1 As indicated	Drawing number FLU.249.BR06
Date 02/02/2020	Rev G
Drawn by C.Tough	