PRICE&MYERS

84 Hatton Garden, Camden

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

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Project ref: 23000

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Executive Summary

This report details the proposed energy strategy for the 84 Hatton Garden scheme, which entails the demolition of 5 stories of an existing 7 storey mixed used development. The existing lower ground floor and ground will be retained. The development will see the refurbishment of the existing lower ground and ground floor to include a new 1 bed duplex with private court yard as well as a new 3 bed quadplex with private court yard at the rear of the development. The existing shop and work shop space shall be retained and refurbished. The rest of the development will see the addition of a further two 1-bed flats, four two-bed flats, as well as a 3 bed duplex penthouse flat. All the apartments will be C1 serviced apartments in the London Borough of Camden.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean)
- Energy efficiency measures (Be Clean)
- Low and zero carbon technologies (Be Green)

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The proposed strategy has the potential to provide a 42.8% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies. Renewable technologies have been specified to achieve a 20% reduction in site wide CO_2 emissions.

Based on the proposed energy strategy, 9 credits can also be achieved in Ene 1 of the BREEAM New Construction 2014 assessment. Further details can be found in the Price & Myers BREEAM New Construction 2014 Pre-assessment report.

1 Introduction

1.1 Site Analysis

The 84 Hatton Garden development is located in in the London Borough of Camden.

The proposal entails the demolition of 5 stories of an existing 7 storey mixed use development. The existing lower ground and ground floors will be retained and refurbished. The new development will see the addition of a further 7 stories as well as a four storey quadplex to the rear of the development. The mixed-use development will comprise of a small commercial unit on the ground floor with work shop space and storage provided on the lower ground floor. All apartments are to be designated as C1 serviced apartments.

The building has a flat roof, the majority of this will be used for placement of PV panels (penthouse roof). The building occupies most of the site, the available outdoor space at ground level has been used as private courtyard space for both the 1-bed duplex and 3-bed quadplex.

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the 84 Hatton Garden scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO_2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Camden and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 London Borough of Camden Policies on Energy

Policy DP22 – Promoting sustainable design and construction

The Council will promote and measure sustainable design and construction by:

- Expecting new build housing to meet Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;
- Expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve "very good" in BREEAM for Domestic Refurbishment assessments prior to 2013 and encouraging "excellent" from 2013;

Policy CPG3 Sustainability

Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.

All residential new build should achieve a Code for Sustainable Homes level 4 with 50% of the unweighted Energy, Water and Materials credits.

Residential refurbishments of 500sqm floorspace or more to achieve a BREEAM for Domestic Refurbishment Very Good.

Pre App Principle Issues

Sustainability

It is indicated that the proposal will utilise an energy efficient building fabric, high efficiency boiler and rooftop photovoltaics. As the proposal would entail the change of use of more than 500sqm of commercial floorspace, an energy statement would be required to demonstrate how the proposed development would reduce carbon dioxide emissions in line with policy CS13 (Tackling climate change through promoting higher environmental standards). Camden Planning Guidance (CPG3 – Sustainability) requires an improvement of 40% on the 2010 Building Regulations for new buildings. Please refer to CPG3 for more information about energy statements.

It is considered that, due to the commercial nature of the proposed use, the relevant sustainability assessment should be BREEAM as opposed to the Code for Sustainable Homes which is for permanent residential schemes. A pre-assessment will be required to accompany any application which a minimum rating of "very good" and a minimum score of 60% in the energy and material categories, and 40% in the water category. This would be verified by a post-construction review. Such a review would be secured as part of a section 106 agreement.

Hatton Garden is to be assessed under BREEAM New Construction 2014 due to all the apartments being C1 serviced.

Part L 2010 has now been superseded by Part L 2013. The calculations for the Hatton Garden project have therefore been based on the methodologies for Part L 2013. As set out in the GLA Guidance on Preparing Energy Assessments 2014 and section 2.4.3 of the London Plan Sustainable Design and Construction SPG, the equivalent target to a 40% improvement over Part L 2010 is a 35% improvement over Part L 2013.

To avoid additional unnecessary calculations and to ensure all the targets for the building are using the same methodology, the 35% improvement over 2013 regulations approach has been taken. We believe that this should be acceptable.

2.2 The London Plan Policies on Energy

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use Renewable energy

The mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emission reductions in buildings:

- 2013 - 2016: 35% improvement over Part L 2013

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy. This report contains a detailed energy assessment in line with the requirements of Policy 5.2.

Policy 5.6: Decentralised Energy in Development Proposals

Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling.

Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7: Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make

them feasible and where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal.

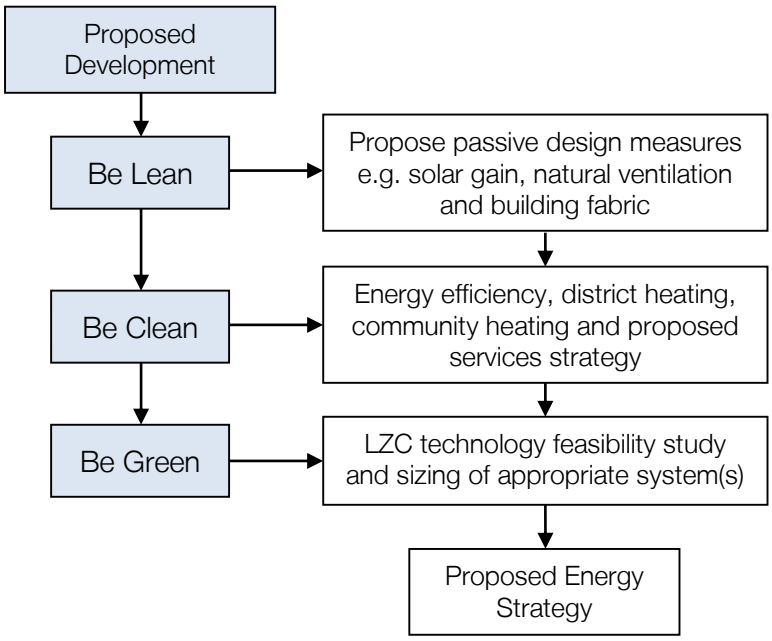
3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean)
- Supply and consume energy efficiently (Be Clean)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed 84 Hatton Gardens development based on the following methodology:



The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Lucy Smallwood who is an On Construction Domestic Energy Assessor (OCDEA). The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version.

4 Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

4.1 Solar Gain Control and Daylighting

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight. The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and using a natural ventilation strategy the risk of solar overheating has been concluded to be not significant for the development.

4.2 Natural Ventilation

Other than mandatory ventilation to meet AD Part F, the development utilises natural ventilation in the form of openable windows. The penthouse duplex will also benefit from the installation of an energy efficient air conditioning unit.

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and using a natural ventilation strategy the risk of solar overheating has been concluded to be not significant for the development.

4.3 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 4-1 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Element	Proposed Measure
External Walls	0.11 W/m^{2}K
Shelter Walls	0.11 W/m^{2}K
Roof	0.12 W/m^{2}K
Ground Floor	0.11 W/m^{2}K
Windows/French Doors/Rooflights	1.2 W/m^{2}K
1 Bed Duplex Windows	1.0 (Triple Glazed)
Flat Doors	1.7 W/m^{2}K
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed: 4 m^3/m^2/h
Thermal Bridging	Y value = Approved Thermal Bridging (To be calculated by Approved Accreditor at detailed design)

Table 4-1 Proposed Be Lean passive design measures

5 Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

5.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't required their own boilers or chillers.

London Borough of Camden heat network has been identified shown in Figure 5-1 below.

Figure 5-1: London Heat Map (black circle indicates location of development)

The connection to a district heating system will be considered at the detailed design stage and further investigation into the provision of appropriate ducts and risers will be carried out to make this possible should such an energy supply become available.

5.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

As this development is relatively small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low

peak demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

5.3 Services Strategy

In addition to the passive design measures identified in Section 4, energy efficient equipment has been proposed where possible to support the services strategy. Table 5-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure
Space Heating	Condensing Gas Boiler 91% Efficient Space Heating from Radiators
Heating Controls	Time and temperature zone control
Hot Water Heating and Storage	Condensing Gas Boiler 90% Efficient Cylinder Sizing: Penthouse and Quadplex 230lt Remaining flats 115lt Independent Time Control Cylinder Stat 100mm foam insulation Fully insulated primary pipework Boiler Interlock
Ventilation	Natural ventilation, localised extract in wet rooms
Comfort Cooling	No cooling
Penthouse Comfort Cooling	Fully air conditioned Energy Rating – A Controls – On/Off
Lighting	100% low energy lighting
Lighting control	PIR and daylight sensors

Table 5-1 Proposed energy efficient design measures

5.4 Improvement Over Part L

Based on the performance of the passive design and energy efficient measures proposed in Sections 4 and 5, as calculated using SAP 2012, Figure 5-2 demonstrates the percentage improvement these have over the notional baseline levels for the development before any low or zero carbon technologies have been considered.

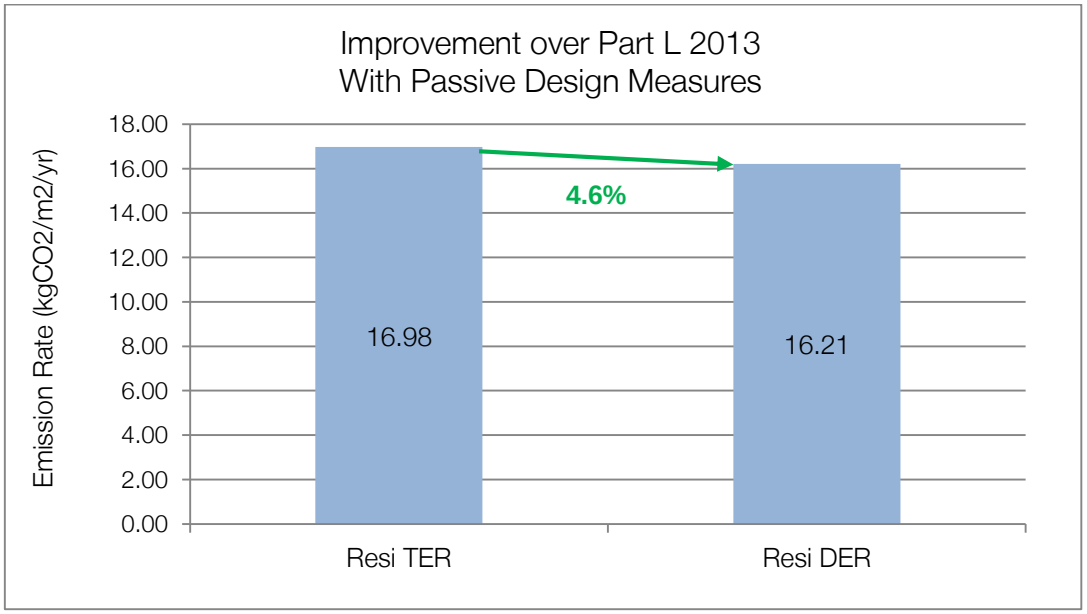


Figure 5-2 Improvement over Building Regulations Part L 2013 before LZCs for residential units

6 Estimated Energy Use and Carbon Footprint

Calculations have been carried out to determine the estimated energy demand and carbon footprint of the proposed development, taking into account the passive design and energy efficiency measures identified in Sections 4 and 5. This will form a base case for the development using gas as the baseline fuel.

The energy consumption includes regulated energy (space and water heating, lighting, pumps and fans) derived from outputs of the SAP calculations for the site and unregulated energy (household appliances and equipment) based on the BRE methodology. Full details of assumptions are included in Appendix A and Table 6-3 details the energy demand for the site taking into account the regulated and unregulated energy for the Baseline. Table 6-1 and Table 6-2 detail the energy demand for the site based on the Be Lean and Be Clean stages of the energy hierarchy

Energy & CO_2												
Type	Gas Demand				Electricity Demand						Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	Appliances (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
Flats	26,050	20,350	46,400	10,022	675	2,931	0	22,239	25,846	13,414	72,246	23,436

Table 6-3: Baseline estimated regulated and unregulated energy demand and carbon emissions per energy source

Energy & CO_2												
Type	Gas Demand				Electricity Demand						Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	Appliances (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
Flats	24,681	20,335	45,015	9,723	675	3,214	0	22,239	26,129	13,561	71,144	23,284

Table 6-4: Be Lean Stage estimated regulated and unregulated energy demand and carbon emissions per energy source

Energy & CO_2												
Type	Gas Demand				Electricity Demand						Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	Appliances (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
Flats	23,281	20,120	43,401	9,375	675	2,908	279	22,239	25,822	13,402	69,503	22,776

Table 6-5: Be Clean Stage estimated regulated and unregulated energy demand and carbon emissions per energy source

7 Low and Zero Carbon (LZC) Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a south facing flat roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✗
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a flat roof on which Solar PV panels could be installed to contribute to the electricity demand of the building	✓

CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable for such a small development Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	✗
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO_2 A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NO_x emissions and delivery vehicles for the fuel	This is a small tight site in an urban area and so there is insufficient space for a biomass boiler system Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO_x emissions	✗

Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	✗
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a no external space available for installation of boreholes	✗

Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development but is discounted due to noise issues and locating the unsightly units	✗

Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be solar PV panels, which would most suitably be installed on the available Penthouse roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

8 Summary of CO2 Emission Savings

8.1 Summary of CO_2 Emissions Savings

The most appropriate LZC technology for the development has been identified as solar PV panels and to meet the London Plan and Borough's target for on-site renewables.

Table 8-1 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development. These have been specified as high efficiency panels to help meet the demand given the available roof space. Further details can be found in Appendix C.

	Energy & CO2				Life Cycle Carbon and Cost Analysis
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO2 saved by system (kgCO2/yr)	% reduction in site CO2 emissions	25 year CO2 saving (kgCO2)
Solar PV – 10.20 kWp 30 deg, South facing Approx 32 panels Approx gross array area = 52.42 m^2 (Areas and efficiency may vary on specification at tender stage)	8,756	12.65%	4,544	20.0%	113,605

Table 8-1 Energy, carbon and financial performance of the proposed LZC technologies

8.2 Be Green Stage Estimated Energy Demand and Carbon Emissions

The proposed LZC technologies can deliver a significant amount of electricity demand reduction. Following the strategy discussed above, Table 8.2 summarises the energy demand of Be Green Stage for the site taking into account the regulated energy.

Energy & CO_2														
Type	Gas Demand				Electricity Demand						LZC Strategy		Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	Space Heating (kWh /yr)	Hot Water (kWh /yr)	Total (kWh /yr)	Gas CO_2 (kg /yr)	Pumps & Fans (kWh /yr)	Lighting (kWh /yr)	Cooling (kWh /yr)	Appliances (kWh /yr)	Total (kWh /yr)	Electricity CO_2 ($kgCO_2$ /yr)	Energy Offset by PV (kWh /yr)	CO_2 saved by PV ($kgCO_2$ /yr)		
Flats	23,281	20,120	43,401	9,375	675	2,908	279	22,239	25,822	13,402	8,756	4,544	60,747	18,232

Table 8-2 Be Green Stage estimated energy demand and carbon emissions per source

The graphs below show the site wide saving from renewable technologies, as well as the improvement over Part L 2013.

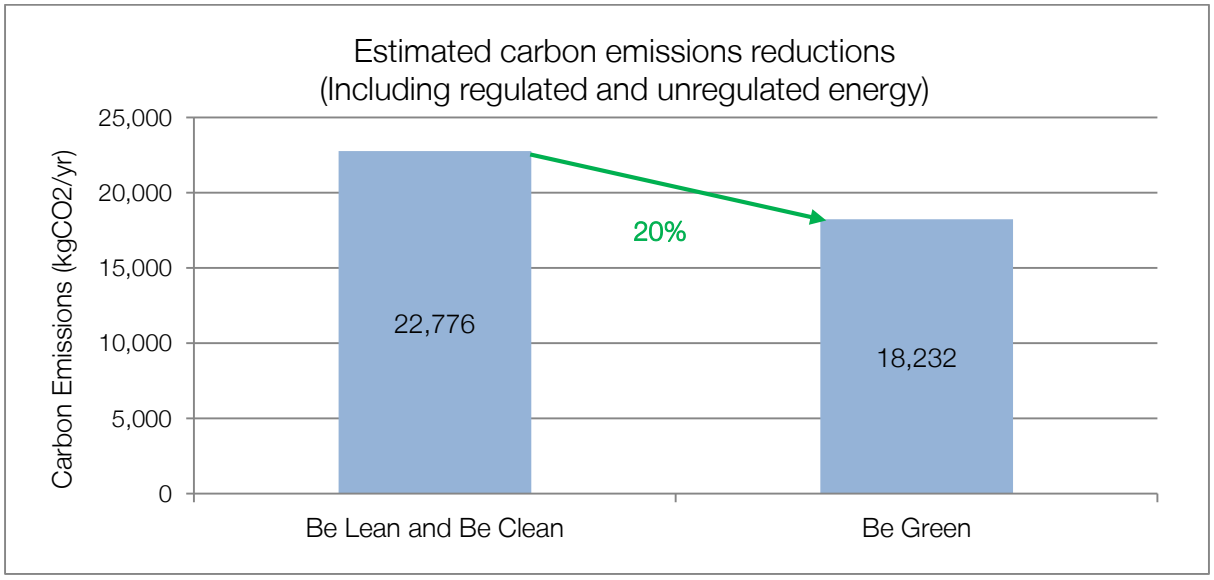


Figure 8-1: Estimated carbon emissions reductions for the site

Based on the feasibility study of LZC technologies in Sections 7 and 8 above, Figure 8-2 demonstrates the percentage improvements over Part L 2013 after incorporating appropriate technologies for each space.

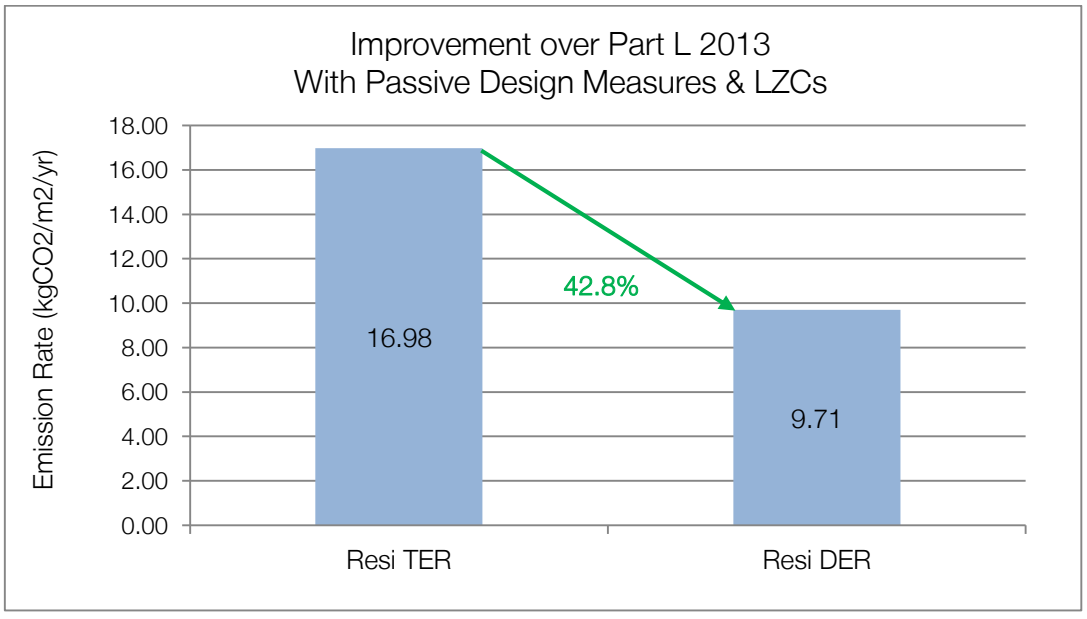


Figure 8-2 Improvement over Building Regulations Part L 2013 after LZCs for residential units

Table 8-3 shows the total site wide carbon saving from the renewable technologies and the percentage improvement over Part L 2013 through the energy hierarchy.

Services	$CO_2/m^2/yr$	Saving
TER	16.98	
DER Be Lean Case	16.82	0.9%
DER Be Clean Case	16.21	4.53%
DER Be Green Case	9.74	42.8%

Figure 8-3 Carbon savings through the energy hierarchy

8.3 BREEAM New Construction 2014

BREEAM New Construction 2014 has set out Energy and CO_2 criteria for the residential units and the number of credits available under Ene 1: Reduction of Energy Use and Carbon Emissions.

According to the SAP results the residential units can achieve a total of 9 credits under Ene 1 in the Energy category of BREEAM New Construction 2014.

9 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 42.8% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and an overall 20% saving in carbon emissions from renewables.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Plan and the London Borough of Camden. The development, achieves an improvement over Part L in excess of 35% in line with the London Plan. The saving from renewables meets the required 20% under Camden Planning policy. In addition fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values are extremely low and far exceed current Building Regulations. Energy efficiency has been maximised throughout the M&E strategy and in the reduction of unregulated energy uses. The PV system specified occupies the majority of available roof space. The strategy therefore represents the best possible savings that could be achieved for this development.

Based on the results of the SAP assessment, the development can achieve a total of 9 credits under the BREEAM New Construction 2014 Pre-Assessment Ene 01.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

10 Appendix A

The following table shows the energy assumptions used for the energy and CO_2 calculations within this report. Calculations for residential areas are based on Standard Assessment Procedure (SAP) results with an inclusion for unregulated energy appliance use not covered by SAP (based on BRE methodology).

The appliances figure is based on the BRE calculation formula for appliances and cooking, taken from the Code for Sustainable Homes in Ene 7 table 1.4, as below.

$kgCO_2$/year from appliances and cooking. See Ene 1:

$$99.9 \times (TFA \times N)^{0.4714} - (3.267 \times TFA) + (32.23 \times N) + 72.6$$

Where:
TFA = Total Floor Area
N = Number of Occupants

For TFA < $43m^2$; N = 1.46
For TFA ≥ $43m^2$; N = $2.844 \times (1 - \exp(-0.000391 \times TFA^2))$

Residential		
Energy Demands		Source
Use Type	Demand (kWh/m^2)	SAP Calculations
Space Heating	33.16	
DHW	28.66	
Fans/Pumps/Controls	0.96	
Lighting	4.14	
Appliances	31.68	BRE Methodology

11 Appendix B

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.216 $kgCO_2/kWh$
Electricity Intensity	0.519 $kgCO_2/kWh$
Grid Displaced Electricity Intensity	0.529 $kgCO_2/kWh$

Table B-1: Energy intensity values

Energy & Renewable Technology Outputs	
PV energy produced per kWp	10.2 kWh/kWp
PV kWp per m^2 panel	0.327 kWp/m^2
Electricity efficiency	100%
Gas boiler efficiency	90%

Table B-2: Renewable technology energy outputs

Fuel Prices (as of Dec 2013)	
Natural Gas	4.37 p/kWh
Electricity (Grid)	13.7 p/kWh

Table B-3: Natural Gas and Electricity fuel prices

12 Appendix C

The following grants may be available with the use of renewable technologies on this development.

Grant	
Feed-in Tariff	By generating your own renewable electricity your energy supplier may pay you money, called a 'Feed-in Tariff' (FIT). Using an MCS certified installer, the system could entitle you to a rate for each unit (kilowatt hour or kWh) of electricity you generate. As well as the FIT, you can sell any excess electricity back to your electricity supplier through an 'Export Tariff'. To qualify, the installation must have a total installed capacity (TIC) of 5 MW or less, with the following technologies covered: • Solar photovoltaic (PV) panels • Wind turbines • Water (Hydro) turbines • Anaerobic digestion (biogas energy) • Micro combined heat and power (micro-CHP) https://www.gov.uk/feed-in-tariffs
Renewable Heat Incentive (RHI)	The RHI is a scheme for both the domestic and non-domestic sector. It provides payments to those that use renewable energy to heat their buildings. In the domestic sector the scheme is open to homeowners, private landlords, social landlords and self-builders. In the non-domestic sector it is open to industry, business and public sector organisations. Payments are made to the owner of the heat installation over a 20-year period, for the following technologies: • Biomass boilers (including CHP biomass boilers) • Ground Source Heat Pumps (GSHP) • Air to Water Heat Pumps (AWHP) • Water Source Heat Pumps • Deep Geothermal Heat Pumps • All solar thermal collectors • Biomethane Injection and Biogas • Energy from Waste (EfW) Domestic RHI • Biomass only boilers and biomass pellet stoves • Air Source Heat Pumps (ASHP) • Ground and Water Source Heat Pumps • Solar thermal panels (flat plate or evacuated tube for hot water only) https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi https://www.ofgem.gov.uk/environmental-programmes/domestic-renewable-heat-incentive https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi
Green Deal	The Green Deal is a Government backed initiative to promote the installation of energy efficiency measures in households in order to reduce energy

	consumption and bills. There will be no upfront costs, instead consumers will pay through their household energy bills. Consumers can see the Green Deal charge alongside the reductions in energy use which generate savings on their bill. It also means that if they move out (and cease to be the bill payer) the financial obligation remains at the property for the next bill payer: the charge is only paid where/whilst the benefits are enjoyed. https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works
ECO (Energy Company Obligation)	ECO is a requirement for all large gas and electricity suppliers to fund energy efficiency improvements to dwellings in the UK. Energy suppliers have specific carbon reduction targets to achieve, and therefore must buy ECO 'credits' of CO_2 on a free market, either from installers (and home owners) or from other energy suppliers. Therefore the price of ECO 'credits' is not fixed. The installer (home owner or private renter with owner's permission) can claim back the money for the installation of the improvement measures from the energy suppliers (full payback or partial refund depending on type of improvement(s) and value of ECO 'credits'). The scheme can be used to fund a number of domestic energy efficiency improvements. If householders are applying for the Green Deal and are eligible for ECO, they will receive a lower quote from their Green Deal Provider and will benefit from lower repayments. The scheme has been extended until 31st March 2017, however there are certain Eligibility requirements. See https://www.gov.uk/energy-company-obligation for more information. Energy Companies Obligation - Guidance for suppliers

Table C-1: A selection of available grants as of 23rd September 2014

13 Appendix D

The following information shows the PV panels specified in the Energy Strategy Report to help meet the required 10% reduction in site energy demand.

SUNPOWER E20/327 SOLAR PANEL

20% EFFICIENCY

SunPower E20 panels are the highest efficiency panels on the market today, providing more power in the same amount of space

MAXIMUM SYSTEM OUTPUT

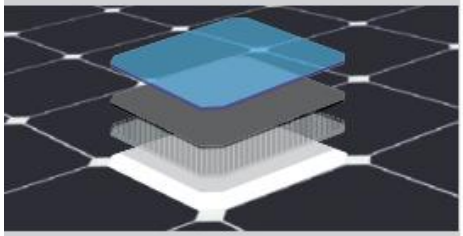
Comprehensive inverter compatibility ensures that customers can pair the highest efficiency panels with the highest-efficiency inverters, maximizing system output

REDUCED INSTALLATION COST

More power per panel means fewer panels per install. This saves both time and money.

RELIABLE AND ROBUST DESIGN

SunPower's unique Maxeon™ cell technology and advanced module design ensure industry-leading reliability



MAXEON™ CELL TECHNOLOGY

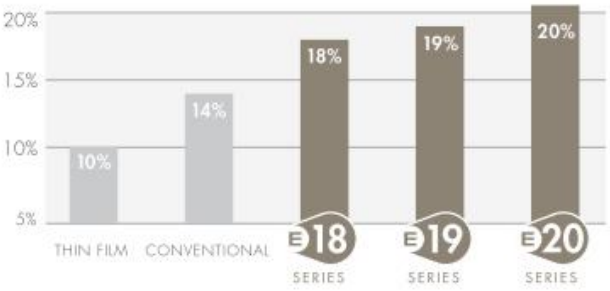
Patented all-back-contact solar cell, providing the industry's highest efficiency and reliability.

E20 SERIES

THE WORLD'S STANDARD FOR SOLAR™

SunPower™ E20 Solar Panels provide today's highest efficiency and performance. Powered by SunPower Maxeon™ cell technology, the E20 series provides panel conversion efficiencies of up to 20.1%. The E20's low voltage temperature coefficient, anti-reflective glass and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.

SUNPOWER'S HIGH EFFICIENCY ADVANTAGE



sunpowercorp.com

c UL us

SUNPOWER E20/327 SOLAR PANEL

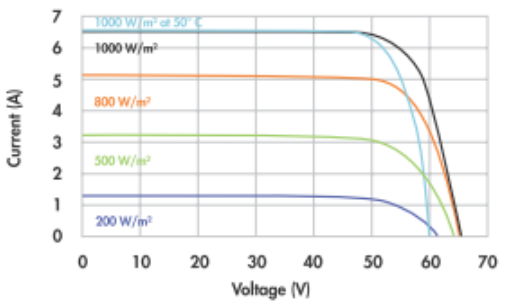
MODEL: SPR-327NE-WHT-D

ELECTRICAL DATA

Measured at Standard Test Conditions (STC): irradiance of 1000W/m², AM 1.5, and cell temperature 25° C

Peak Power (+5/-3%)	P_{max}	327 W
Cell Efficiency	η	22.5 %
Panel Efficiency	η	20.1 %
Rated Voltage	V_{mpp}	54.7 V
Rated Current	I_{mpp}	5.98 A
Open-Circuit Voltage	V_{oc}	64.9 V
Short-Circuit Current	I_{sc}	6.46 A
Maximum System Voltage	UL	600 V
Temperature Coefficients	Power (P)	-0.38% / K
	Voltage (V_{OC})	-176.6mV / K
	Current (I_{SC})	3.5mA / K
NOCT		45° C +/-2° C
Series Fuse Rating		20 A
Grounding	Positive grounding not required	

I-V CURVE



Current/voltage characteristics with dependence on irradiance and module temperature.

MECHANICAL DATA

Solar Cells	96 SunPower Maxeon™ cells
Front Glass	High transmission tempered glass with anti-reflective (AR) coating
Junction Box	IP-65 rated with 3 bypass diodes Dimensions: 32 x 155 x 128 mm
Output Cables	1000mm length cables / MultiContact (MC4) connectors
Frame	Anodized aluminum alloy type 6063 (black)
Weight	41.0 lbs (18.6 kg)

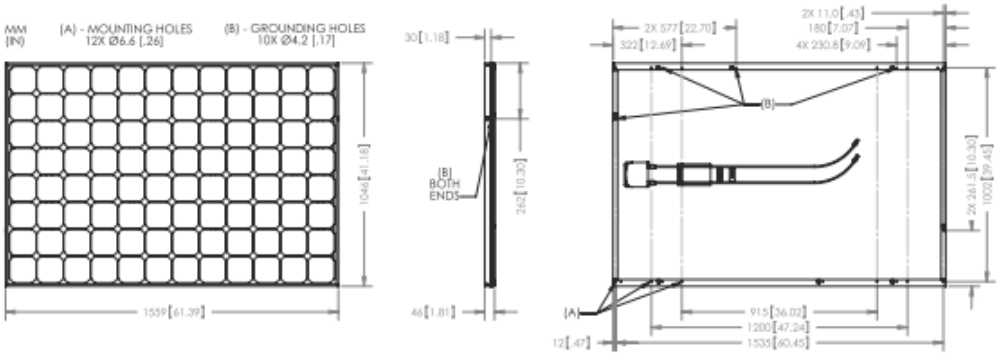
TESTED OPERATING CONDITIONS

Temperature	-40° F to +185° F (-40° C to + 85° C)
Max load	113psf 550 kg/m² (5400 Pa), front (e.g. snow) w / specified mounting configurations 50 psf 245 kg/m² (2400 Pa) front and back – e.g. wind
Impact Resistance	Hail: (25 mm) at 51mph (23 m/s)

WARRANTIES AND CERTIFICATIONS

Warranties	25-year limited power warranty
	10-year limited product warranty
Certifications	Tested to UL 1703. Class C Fire Rating

DIMENSIONS



Please read safety and installation instructions before using this product, visit sunpowercorp.com for more details.

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Document #001-65684 Rev*B / LTR_EN

CS 11_242

14 Appendix E

SAP Assumptions and Calculations

U-Values

Element	Proposed Measure
External Walls	0.11 W/m^{2}K
Shelter Walls	0.11 W/m^{2}K
Roof	0.12 W/m^{2}K
Ground Floor	0.11 W/m^{2}K
Windows/French Doors/Rooflights	1.2 W/m^{2}K
1 Bed Duplex Windows	1.0 (Triple Glazed)
Flat Doors	1.7 W/m^{2}K
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed: 4 m^3/m^2/h
Thermal Bridging	Y value = Approved Thermal Bridging (To be calculated by Approved Accreditor at detailed design)

Services

Services	Measure
Space Heating	Condensing Gas Boiler 91% Efficient Space Heating from Radiators
Heating Controls	Time and temperature zone control
Hot Water Heating and Storage	Condensing Gas Boiler 90% Efficient Cylinder Sizing Penthouse and Quadplex 230lt Remaining flats 115lt Independent Time Control Cylinder Stat 100mm foam insulation Fully insulated primary pipework Boiler Interlock
Ventilation	Natural ventilation, localised extract in wet rooms

Comfort Cooling	No cooling
Penthouse Comfort Cooling	Fully air conditioned Energy Rating – A Controls – On/Off
Lighting	100% low energy lighting
Lighting control	PIR and daylight sensors

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 23000 3 Bed Penthouse Duplex
Survey Reference: Penthouse - Be Lean
Property: London, EC1N 8JR

Issued on Date: 24.Mar.2015
Prop Type Ref:

SAP Rating:	84 B	**CO2 Emissions (t/year):**	1.74	**DER:** 16.52 Fail	**TER:** 16.15	**Percentage DER<TER:**	-2.31 %
Environmental:	84 B	**General Requirements Compliance:**	Fail	**DFEE:** 49.27 Pass	**TFEE:** 55.75	**Percentage DFEE<TFEE:**	11.62 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: admin Admin, Tel: 4, Fax: s@l.f Surveyor ID: Admin
Address:
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 2.02r19
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Penthouse - Be Lean'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Flat)     25/03/2015

FullRefNo:                    Penthouse - Be Lean

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     EC1N 8JR
DwellingOrientation:          North
Property Type:                Flat, End-Terrace
Storeys:                      2
Date Built:                   2015
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              39.29, 69.8, 2.87
    2nd Storey:              30.57, 66.24, 2.95
Living Area:                  40.74 m2, fraction: 29.9%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Medium
Thermal MassValue:            250
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               77.23, 150.02, 150, Other, Cavity, 0, 0.11, Gross
Shelter Wall                  50.19, 51.95, 18, Other, Cavity, 0.43, 0.105031987014227, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  44.61, 110, PartyWallSinglePlasterLightweight, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Penthouse GF Roof        16.89, 16.89, 0, Other, 0.11
    Penthouse FF Roof        66.63, 70.18, 0, Other, 0.11
Heat Loss Floors              Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            69.8, 30
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                Manufacturer, Door to Corridor, , , , , , ,
    French Doors             Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Skylight                 Manufacturer, Roof Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Flat Door                Door to Corridor, Shelter Wall, North, , , , , 0, 0, 0, 1.76,
    Front French Doors       Window, External Wall 1, East, , None, 0, , 0, 0, 0, 5.44,
    Front Windows            Window, External Wall 1, East, , None, 0, , 0, 0, 0, 10.89,
    Side Windows             Window, External Wall 1, South, , None, 0, , 0, 0, 0, 31.93,
    Rear Windows             Window, External Wall 1, West, , None, 0, , 0, 0, 0, 13.64,
    Rear French Door         Window, External Wall 1, West, , None, 0, , 0, 0, 0, 10.89,
    Skylight Door            Roof Window, Penthouse FF Roof, East, 0, None, , , 0, 0, 0, 3.55,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.071
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 28.88, 0.3, 0.3, 8.66,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 28.08, 0.04, 0.04, 1.12,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 69.88, 0.05, 0.05, 3.49,
    3.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 30.57, 0.07, 0.07, 2.14,
    4.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 39.29, 0.07, 0.07, 2.75,
    5.                       External wall, E16 Corner (normal), Table K1 - Approved, Yes, 11.64, 0.09, 0.09, 1.05,
    6.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 11.64, 0.06, 0.06, 0.70,
    7.                       External roof, R1 Head of roof window, Table K1 - Default, Yes, 2.45, 0.08, 0.08, 0.20,
    8.                       External roof, R2 Sill of roof window, Table K1 - Default, Yes, 2.45, 0.06, 0.06, 0.15,
    9.                       External roof, R3 Jamb of roof window, Table K1 - Default, Yes, 2.9, 0.08, 0.08, 0.23,
Pressure Test:                True
Designed q50:                 5
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System
    Cooled Area              137.04
```

```
    Data Source             SAP table
    Type                    Split or Multi-Split
    Class                   A
    Control                 On/Off
Light Fittings:              16
LEL Fittings:                14
Percentage of LEL Fittings:  87.5
External Lights Fitted:      Yes
External LELs Fitted:        Yes
Electricity Tariff:          Standard
Main Heating 1
    Description
    Percentage              100
    MHS                     Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                102
    Boiler Efficiency Type  Sedbuk 2009
    Efficiency              90
    Model Name              tbc
    Manufacturer            tbc
    Controls by PCDF        0
    MHS Controls            CBI Time and temperature zone control
    Boiler Interlock        Yes
    Compensator             0
    Delayed Start Stat      Yes
    Ctrl SAP Code           2110
    Burner Control          OnOff
    Flue Type               Balanced
    Fan Assisted Flue       Yes
    Pumped                  Pump in heated space
    Heat Pump Age           2013 or later
    Heat Emitter            Radiators
    Flow Temperature        Normal (> 45°C)
Main Heating 2               None
Heating Systems Interaction  Each system heats separate parts of dwelling
Smoke Control Area           Unknown
Community Heating            None
Secondary Heating            None
Water Heating
    Type                    MainHeating1
    WHS                     HWP From main heating 1
    Low Water Usage         Yes
    SAP Code                901
    Showers in Property     Non-electric only
    Hot Water Cylinder
    Cylinder Type           HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume         230.00
    Cylinder Stat           Yes
    Pipeworks Insulated     Fully insulated primary pipework
    Cylinder in Heated Space Yes
    Separate Time Control   Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery    none
PV Unit                      None
Wind Turbine                 None
Terrain Type:                Urban
Small Scale Hydro            None
Special Features             None


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

DWELLING AS DESIGNED

Top-floor flat, total floor area 136 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.15 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.52 kg/m²Fail
Excess emissions =0.37 kg/m²  (2.3%)
-------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)49.3 kWh/m²OK
-------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.11 (max. 0.30)        0.11 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.11 (max. 0.20)        0.11 (max. 0.35)          OK
Openings        1.20 (max. 2.00)        1.70 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         5.00 (design value)
Maximum                                 10.0                                            OK
-------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 90.0% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 1.91 kWh/day
Permitted by DBSCG 2.43                         OK
Primary pipework insulated:             Yes                                             OK
```

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6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

7 Low energy lights

Percentage of fixed lights with low-energy fittings:88%

Minimum	75%	OK

---

8 Mechanical ventilation

Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	16.33 m^2, No overhang	
Windows facing South:	31.93 m^2, No overhang	
Windows facing West:	24.53 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

---

10 Key features

External wall U-value	0.11 W/m^2K
External wall U-value	0.11 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Roof U-value	0.11 W/m^2K
Roof window U-value	1.00 W/m^2K

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(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	0.4141	0.4059	0.3978	0.3572	0.3491	0.3085	0.3085	0.3004	0.3247	0.3491	0.3653	0.3816	(22b)
Effective ac	0.5857	0.5824	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5728	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	76.4904	76.0558	75.6297	73.6284	73.2539	71.5109	71.5109	71.1881	72.1823	73.2539	74.0114	74.8033	(38)
Heat transfer coeff	209.6897	209.2550	208.8289	206.8276	206.4532	204.7101	204.7101	204.3873	205.3815	206.4532	207.2107	208.0026	(39)
Average = Sum(39)m / 12 =												206.8258	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5414	1.5382	1.5351	1.5203	1.5176	1.5048	1.5048	1.5024	1.5097	1.5176	1.5232	1.5290	(40)
HLP (average)												1.5203	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.5761	27.1574	22.0859	16.7204	12.4987	10.5519	11.4017	14.8204	19.8919	25.2574	29.4791	31.4259	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	539.6819	537.0407	519.0424	489.9695	459.9512	431.7117	413.8762	420.8375	436.2637	465.5725	499.0901	524.7043	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1274.2987	1832.8166	2383.2942	2909.2157	3237.8793	3211.0892	3085.1522	2826.8162	2496.0235	1924.8863	1387.7354	1147.3743	(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	45.0533	45.1469	45.2391	45.6768	45.7596	46.1493	46.1493	46.2222	45.9984	45.7596	45.5924	45.4188	
alpha	4.0036	4.0098	4.0159	4.0451	4.0506	4.0766	4.0766	4.0815	4.0666	4.0506	4.0395	4.0279	
util living area													
	0.9888	0.9583	0.8836	0.7373	0.5617	0.4017	0.2906	0.3301	0.5417	0.8432	0.9722	0.9924	(86)
MIT	19.5554	19.9603	20.4051	20.7688	20.9344	20.9868	20.9973	20.9954	20.9579	20.6610	20.0103	19.4787	(87)
Th 2	19.6566	19.6590	19.6613	19.6723	19.6743	19.6839	19.6839	19.6857	19.6802	19.6743	19.6702	19.6658	(88)
util rest of house													
	0.9851	0.9459	0.8533	0.6834	0.4918	0.3219	0.2044	0.2371	0.4485	0.7910	0.9617	0.9898	(89)
MIT 2	17.8021	18.3796	18.9859	19.4452	19.6231	19.6771	19.6832	19.6843	19.6549	19.3418	18.4676	17.6973	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.3272	18.8529	19.4109	19.8416	20.0158	20.0694	20.0767	20.0770	20.0451	19.7369	18.9296	18.2308	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1772	18.7029	19.2609	19.6916	19.8658	19.9194	19.9267	19.9270	19.8951	19.5869	18.7796	18.0808	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9791	0.9343	0.8427	0.6843	0.5022	0.3364	0.2204	0.2543	0.4643	0.7870	0.9520	0.9852	(94)
Useful gains	1247.6055	1712.3632	2008.3078	1990.7521	1626.1928	1080.1291	679.8878	718.8315	1158.8287	1514.8589	1321.0835	1130.4055	(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													
	2909.8975	2888.3352	2664.8419	2231.9967	1685.8592	1088.9258	681.0105	720.8653	1190.2093	1855.3685	2420.1404	2887.2403	(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													
	1236.7452	790.2532	488.4614	173.6961	44.3918	0.0000	0.0000	0.0000	0.0000	253.3391	791.3209	1307.0851	(98)
Space heating												5085.2929	(98)
Space heating per m2											(98) / (4) =	37.3809	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1924.2752	1514.8549	1553.3438	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9686	0.9839	0.9768	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1863.8770	1490.4247	1517.3698	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3815.9868	3668.8158	3376.1465	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1405.5191	1620.7230	1382.9299	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4409.1720 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	353.9627	408.1591	348.2739	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1110.3957 (107)
Space cooling per m2 8.1623 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5594.3816 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1236.7452	790.2532	488.4614	173.6961	44.3918	0.0000	0.0000	0.0000	0.0000	253.3391	791.3209	1307.0851	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	1360.5558	869.3655	537.3612	191.0849	48.8359	0.0000	0.0000	0.0000	0.0000	278.7009	870.5401	1437.9374	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 80.8000 (216)

(217)m	89.1926	88.6863	87.6370	85.3818	82.5966	80.8000	80.8000	80.8000	80.8000	86.2412	88.6324	89.3023	(217)

Fuel for water heating, kWh/month

250.7485	222.3381	236.4565	217.7892	220.7900	201.9160	194.1521	212.7234	212.2469	223.5736	229.7580	244.4870	(219)

Water heating fuel used 2666.9793 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	88.4907	102.0398	87.0685	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 277.5989 (221)
Annual totals kWh/year
Space heating fuel - main system 5594.3816 (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) 539.9829 (232)
Total delivered energy for all uses 9153.9427 (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	5594.3816	0.2160	1208.3864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2666.9793	0.2160	576.0675	(264)
Space and water heating			1784.4540	(265)
Space cooling	277.5989	0.5190	144.0738	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	539.9829	0.5190	280.2511	(268)
Total CO2, kg/year			2247.7039	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.5200	(273)

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

DER		16.5200	ZC1
Total Floor Area	TFA	136.0400	
Assumed number of occupants	N	2.9091	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.2796	ZC2
CO2 emissions from cooking, equation (L16)		1.3880	ZC3
Total CO2 emissions		31.1875	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		31.1875	ZC8

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(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	0.4141	0.4059	0.3978	0.3572	0.3491	0.3085	0.3085	0.3004	0.3247	0.3491	0.3653	0.3816	(22b)
Effective ac	0.5857	0.5824	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5728	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8811			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4133	(36)
Total fabric heat loss (33) + (36) =	97.2944	(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	76.4904	76.0558	75.6297	73.6284	73.2539	71.5109	71.5109	71.1881	72.1823	73.2539	74.0114	74.8033	(38)
Heat transfer coeff	173.7849	173.3502	172.9241	170.9228	170.5484	168.8053	168.8053	168.4825	169.4767	170.5484	171.3058	172.0977	(39)
Average = Sum(39)m / 12 =												170.9210	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2775	1.2743	1.2711	1.2564	1.2537	1.2409	1.2409	1.2385	1.2458	1.2537	1.2592	1.2651	(40)
HLP (average)												1.2564	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7973 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.9706 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(56)
If cylinder contains dedicated solar storage	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(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

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             221.8465   195.5552   205.4207   184.2079   180.5625   161.4037   155.0724   170.0780   169.7511   191.0099   201.8957   216.5299 (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
             221.8465   195.5552   205.4207   184.2079   180.5625   161.4037   155.0724   170.0780   169.7511   191.0099   201.8957   216.5299 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   2253.3335 (64)
Heat gains from water heating, kWh/month
               98.7049    87.5494    93.2433    85.3855    84.9780    77.8031    76.5025    81.4919    80.5786    88.4518    91.2667    96.9371 (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          145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               27.1787    24.1399    19.6319    14.8626    11.1100     9.3795    10.1349    13.1737    17.6817    22.4510    26.2036    27.9341 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              304.8627   308.0262   300.0542   283.0828   261.6595   241.5246   228.0733   224.9097   232.8817   249.8531   271.2764   291.4113 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457 (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)
             -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654 (71)
Water heating gains (Table 5)
              132.6679   130.2819   125.3270   118.5910   114.2177   108.0599   102.8260   109.5321   111.9148   118.8868   126.7593   130.2918 (72)
Total internal gains
              534.3463   532.0850   514.6502   486.1735   456.6242   428.6011   410.6711   417.2526   432.1153   460.8279   493.8764   519.2743 (73)



-------------------------------------------------------------------------------------------------------
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                                    6.9000            19.6403              0.6300              0.7000            0.7700            41.4160 (76)
South                                  13.4900            46.7521              0.6300              0.7000            0.7700           192.7456 (78)
West                                   10.3500            19.6403              0.6300              0.7000            0.7700            62.1240 (80)
East                                    1.5000            26.0000              0.6300              0.7000            1.0000            15.4791 (82)
-------------------------------------------------------------------------------------------------------

Solar gains    311.7648   550.3628   792.8231  1030.2524  1184.0933  1185.1493  1138.8752  1025.0351   876.4607   620.1085   377.2181   264.1986 (83)
Total gains    846.1111  1082.4478  1307.4732  1516.4259  1640.7175  1613.7503  1549.5463  1442.2876  1308.5760  1080.9364   871.0945   783.4729 (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            54.3616    54.4979    54.6322    55.2719    55.3932    55.9652    55.9652    56.0724    55.7435    55.3932    55.1483    54.8945
alpha           4.6241     4.6332     4.6421     4.6848     4.6929     4.7310     4.7310     4.7382     4.7162     4.6929     4.6766     4.6596
util living area
                0.9976     0.9924     0.9761     0.9248     0.8101     0.6326     0.4715     0.5239     0.7757     0.9593     0.9942     0.9983 (86)

MIT            19.6114    19.8411    20.1684    20.5491    20.8259    20.9596    20.9918    20.9868    20.8953    20.5008    19.9745    19.5739 (87)
Th 2           19.8585    19.8611    19.8635    19.8751    19.8773    19.8875    19.8875    19.8893    19.8835    19.8773    19.8729    19.8683 (88)
util rest of house
                0.9968     0.9898     0.9678     0.8992     0.7515     0.5376     0.3563     0.4042     0.6895     0.9402     0.9918     0.9978 (89)
MIT 2          18.0201    18.3560    18.8293    19.3669    19.7169    19.8625    19.8847    19.8844    19.8061    19.3156    18.5602    17.9720 (90)
Living area fraction                                                                                      fLA = Living area / (4) =      0.2995 (91)
MIT            18.4966    18.8008    19.2303    19.7209    20.0490    20.1911    20.2162    20.2145    20.1323    19.6706    18.9837    18.4517 (92)
Temperature adjustment                                                                                                              0.0000
adjusted MIT   18.4966    18.8008    19.2303    19.7209    20.0490    20.1911    20.2162    20.2145    20.1323    19.6706    18.9837    18.4517 (93)



-------------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9953     0.9863     0.9618     0.8950     0.7614     0.5647     0.3910     0.4402     0.7107     0.9356     0.9891     0.9967 (94)
Useful gains   842.1580  1067.6596  1257.5511  1357.2120  1249.1772   911.3308   605.9084   634.8691   930.0076  1011.3400   861.6102   780.8536 (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
            2467.1610  2409.6986  2201.3738  1849.5459  1423.9072   943.8046   610.4401   642.6795  1022.3354  1546.9708  2035.7533  2452.6857 (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
            1209.0022   901.8502   702.2041   354.4804   129.9991     0.0000     0.0000     0.0000     0.0000   398.5093   845.3830  1243.8431 (98)
Space heating                                                                                                                      5785.2715 (98)
Space heating per m2                                                                                                 (98) / (4) =     42.5263 (99)



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8c. Space cooling requirement
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Not applicable



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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                                                                                                   6187.4562 (211)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
            1209.0022   901.8502   702.2041   354.4804   129.9991     0.0000     0.0000     0.0000     0.0000   398.5093   845.3830  1243.8431 (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)
1293.0505 964.5457 751.0204 379.1235 139.0365 0.0000 0.0000 0.0000 0.0000 426.2132 904.1530 1330.3134 (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
221.8465 195.5552 205.4207 184.2079 180.5625 161.4037 155.0724 170.0780 169.7511 191.0099 201.8957 216.5299 (64)
Efficiency of water heater 79.8000 (216)
(217)m 88.6569 88.3881 87.8345 86.5324 83.9550 79.8000 79.8000 79.8000 79.8000 86.7319 88.2196 88.7359 (217)
Fuel for water heating, kWh/month
250.2304 221.2461 233.8725 212.8774 215.0705 202.2603 194.3263 213.1303 212.7207 220.2302 228.8558 244.0162 (219)
Water heating fuel used 2648.8369 (219)
Annual totals kWh/year
Space heating fuel - main system 6187.4562 (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) 479.9848 (232)
Total delivered energy for all uses 9391.2779 (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	6187.4562	0.2160	1336.4905 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2648.8369	0.2160	572.1488 (264)
Space and water heating			1908.6393 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	479.9848	0.5190	249.1121 (268)
Total CO2, kg/m2/year			2196.6764 (272)
Emissions per m2 for space and water heating			14.0300 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8312 (272b)
Emissions per m2 for pumps and fans			0.2861 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0300 * 1.00) + 1.8312 + 0.2861, rounded to 2 d.p.			16.1500 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(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) =	0.2984	(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	0.3805	0.3730	0.3656	0.3283	0.3208	0.2835	0.2835	0.2760	0.2984	0.3208	0.3357	0.3506	(22b)
Effective ac	0.5724	0.5696	0.5668	0.5539	0.5515	0.5402	0.5402	0.5381	0.5445	0.5515	0.5564	0.5615	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	74.7487	74.3817	74.0219	72.3320	72.0158	70.5439	70.5439	70.2714	71.1109	72.0158	72.6554	73.3241	(38)
Heat transfer coeff	207.9480	207.5809	207.2211	205.5312	205.2150	203.7432	203.7432	203.4706	204.3101	205.2150	205.8547	206.5234	(39)
Average = Sum(39)m / 12 =												205.5297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5286	1.5259	1.5232	1.5108	1.5085	1.4977	1.4977	1.4957	1.5018	1.5085	1.5132	1.5181	(40)
HLP (average)												1.5108	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)

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

	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)

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

	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)

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

	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)

	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)

Water heating gains (Table 5)

	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)

Total internal gains

	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1181.4210	1741.1799	2294.0092	2822.9579	3153.6689	3129.3175	3005.1750	2744.0390	2411.8228	1837.5732	1297.1120	1055.2598	(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	45.4307	45.5110	45.5901	45.9649	46.0357	46.3683	46.3683	46.4304	46.2396	46.0357	45.8927	45.7441	
alpha	4.0287	4.0341	4.0393	4.0643	4.0690	4.0912	4.0912	4.0954	4.0826	4.0690	4.0595	4.0496	
util living area	0.9914	0.9641	0.8930	0.7487	0.5716	0.4098	0.2968	0.3383	0.5555	0.8578	0.9776	0.9944	(86)
MIT	19.5137	19.9253	20.3820	20.7581	20.9314	20.9861	20.9971	20.9951	20.9546	20.6384	19.9683	19.4341	(87)
Th 2	19.6661	19.6681	19.6701	19.6794	19.6811	19.6892	19.6892	19.6908	19.6861	19.6811	19.6776	19.6739	(88)
util rest of house	0.9885	0.9532	0.8645	0.6956	0.5013	0.3289	0.2092	0.2434	0.4612	0.8083	0.9689	0.9924	(89)
MIT 2	18.3567	18.7598	19.1879	19.5162	19.6443	19.6843	19.6887	19.6897	19.6673	19.4360	18.8149	18.2839	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.7032	19.1088	19.5455	19.8881	20.0298	20.0742	20.0805	20.0806	20.0528	19.7961	19.1603	18.6284	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7032	19.1088	19.5455	19.8881	20.0298	20.0742	20.0805	20.0806	20.0528	19.7961	19.1603	18.6284	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9856	0.9474	0.8614	0.7046	0.5205	0.3530	0.2355	0.2719	0.4885	0.8133	0.9644	0.9903	(94)
Useful gains	1164.4003	1649.6459	1976.0332	1989.0067	1641.5747	1104.7259	707.6613	746.2308	1178.2075	1494.4389	1250.9782	1045.0238	(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	2995.1100	2949.4754	2703.2969	2258.4042	1709.3923	1115.3239	709.1347	748.9035	1216.2216	1887.1805	2482.6632	2979.8004	(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	1362.0481	873.4854	541.0842	193.9662	50.4563	0.0000	0.0000	0.0000	0.0000	292.1998	886.8132	1439.4738	(98)
Space heating												5639.5269	(98)
Space heating per m2											(98) / (4) =	41.4549	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1915.1859	1507.6996	1546.3767	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9672	0.9831	0.9755	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1852.4192	1482.2561	1508.4935	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3735.4565	3589.9383	3293.8992	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1355.7868	1568.1156	1328.3418	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												4252.2442	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	338.9467	392.0289	332.0855	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												1063.0611	(107)
Space cooling per m2												7.8143	(108)
Energy for space heating												41.4549	(99)
Energy for space cooling												7.8143	(108)
Total												49.2692	(109)

Dwelling Fabric Energy Efficiency (DFEE) 49.3 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(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) =	0.2984	(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	0.3805	0.3730	0.3656	0.3283	0.3208	0.2835	0.2835	0.2760	0.2984	0.3208	0.3357	0.3506	(22b)
Effective ac	0.5724	0.5696	0.5668	0.5539	0.5515	0.5402	0.5402	0.5381	0.5445	0.5515	0.5564	0.5615	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		85.8811			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4133	(36)
Total fabric heat loss					(33) + (36) =		97.2944	(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	74.7487	74.3817	74.0219	72.3320	72.0158	70.5439	70.5439	70.2714	71.1109	72.0158	72.6554	73.3241	(38)
Heat transfer coeff	172.0432	171.6761	171.3163	169.6264	169.3102	167.8384	167.8384	167.5658	168.4053	169.3102	169.9498	170.6185	(39)
Average = Sum(39)m / 12 =												169.6249	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2647	1.2620	1.2593	1.2469	1.2446	1.2337	1.2337	1.2317	1.2379	1.2446	1.2493	1.2542	(40)
HLP (average)												1.2469	(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		2.9091 (42)
Average daily hot water use (litres/day)		103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)

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

	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)

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

	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)

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

	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)

	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)

Water heating gains (Table 5)

	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)

Total internal gains

	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	6.9000	19.6403	0.6300	0.7000	0.7700	41.4160	(76)
South	13.4900	46.7521	0.6300	0.7000	0.7700	192.7456	(78)
West	10.3500	19.6403	0.6300	0.7000	0.7700	62.1240	(80)
East	1.5000	26.0000	0.6300	0.7000	1.0000	15.4791	(82)

Solar gains	311.7648	550.3628	792.8231	1030.2524	1184.0933	1185.1493	1138.8752	1025.0351	876.4607	620.1085	377.2181	264.1986	(83)
Total gains	758.5690	995.7668	1222.5805	1433.9642	1559.8341	1535.0893	1472.7742	1363.0953	1228.5237	998.3679	785.6848	696.7883	(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	54.9119	55.0293	55.1449	55.6943	55.7983	56.2876	56.2876	56.3792	56.0981	55.7983	55.5883	55.3704	
alpha	4.6608	4.6686	4.6763	4.7130	4.7199	4.7525	4.7525	4.7586	4.7399	4.7199	4.7059	4.6914	
util living area	0.9985	0.9945	0.9812	0.9362	0.8290	0.6556	0.4918	0.5485	0.8020	0.9691	0.9962	0.9990	(86)
MIT	19.5693	19.8000	20.1306	20.5183	20.8090	20.9539	20.9904	20.9843	20.8799	20.4616	19.9289	19.5296	(87)
Th 2	19.8686	19.8708	19.8728	19.8827	19.8845	19.8931	19.8931	19.8947	19.8898	19.8845	19.8808	19.8769	(88)
util rest of house	0.9980	0.9926	0.9745	0.9135	0.7731	0.5598	0.3731	0.4252	0.7191	0.9537	0.9947	0.9987	(89)
MIT 2	18.5693	18.8007	19.1286	19.5076	19.7624	19.8733	19.8909	19.8906	19.8276	19.4639	18.9378	18.5362	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9909	0.9712	0.9118	0.7837	0.5875	0.4089	0.4625	0.7402	0.9516	0.9934	0.9982	(94)
Useful gains	756.5520	986.6987	1187.3531	1307.4891	1222.4544	901.8294	602.2556	630.3827	909.3499	950.0377	780.4790	695.5266	(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	2506.4566	2437.7894	2214.8905	1850.6658	1418.1177	939.3799	607.5992	639.7860	1017.6257	1551.3329	2062.2771	2496.7788	(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	1301.9290	975.1329	764.4878	391.0872	145.5735	0.0000	0.0000	0.0000	0.0000	447.3637	922.8946	1340.1317	(98)
Space heating												6288.6004	(98)
Space heating per m2											(98) / (4) =	46.2261	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1577.6805	1242.0038	1273.5000	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8924	0.9419	0.9214	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1407.9716	1169.8909	1173.3894	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1895.0155	1820.5013	1697.8191	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	350.6716	484.0542	390.1757	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1224.9015	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	87.6679	121.0135	97.5439	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												306.2254	(107)
Space cooling per m2												2.2510	(108)
Energy for space heating												46.2261	(99)
Energy for space cooling												2.2510	(108)
Total												48.4771	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3410	0.3247	0.3166	0.3004	0.3004	0.2598	0.2760	0.2679	0.2598	0.2760	0.2760	0.3085	(22b)
Effective ac	0.5581	0.5527	0.5501	0.5451	0.5451	0.5337	0.5381	0.5359	0.5337	0.5381	0.5381	0.5476	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	72.8881	72.1823	71.8423	71.1881	71.1881	69.7033	70.2714	69.9830	69.7033	70.2714	70.2714	71.5109	(38)
Heat transfer coeff	206.0874	205.3815	205.0415	204.3873	204.3873	202.9025	203.4706	203.1823	202.9025	203.4706	203.4706	204.7101	(39)

Average = Sum(39)m / 12 = 204.1162 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5149	1.5097	1.5072	1.5024	1.5024	1.4915	1.4957	1.4935	1.4915	1.4957	1.4957	1.5048	(40)
HLP (average)												1.5004	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
RHI water heating demand												2275 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	76.4402	67.8935	55.2147	41.8011	31.2468	26.3799	28.5044	37.0511	49.7298	63.1435	73.6977	78.5647	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	782.6118	776.4008	746.8687	701.3886	654.4860	613.4092	590.2231	600.7542	627.7142	673.4302	723.8321	762.2837	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834 (83)
Total gains	1568.4413	2021.0470	2546.5429	3134.7445	3364.1438	3511.9879	3381.1233	3174.5675	2830.3542	2204.8554	1705.4956	1444.6671 (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	45.8409	45.9984	46.0747	46.2222	46.2222	46.5604	46.4304	46.4963	46.5604	46.4304	46.4304	46.1493	
alpha	4.0561	4.0666	4.0716	4.0815	4.0815	4.1040	4.0954	4.0998	4.1040	4.0954	4.0954	4.0766	
util living area													
	0.9689	0.9256	0.8147	0.6215	0.4289	0.2421	0.1324	0.1535	0.3550	0.7018	0.9228	0.9760	(86)
MIT	19.9559	20.2560	20.6437	20.8982	20.9813	20.9987	20.9999	20.9999	20.9937	20.8685	20.3968	19.8966	(87)
Th 2	19.6763	19.6802	19.6821	19.6857	19.6857	19.6939	19.6908	19.6923	19.6939	19.6908	19.6908	19.6839	(88)
util rest of house													
	0.9585	0.9039	0.7701	0.5566	0.3541	0.1671	0.0536	0.0699	0.2640	0.6227	0.8955	0.9678	(89)
MIT 2	18.3903	18.8061	19.3088	19.5984	19.6746	19.6936	19.6907	19.6923	19.6916	19.5857	19.0163	18.3124	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8592	19.2403	19.7086	19.9877	20.0659	20.0844	20.0828	20.0839	20.0816	19.9699	19.4297	18.7869	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7092	19.0903	19.5586	19.8377	19.9159	19.9344	19.9328	19.9339	19.9316	19.8199	19.2797	18.6369	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.8920	0.7654	0.5644	0.3674	0.1810	0.0682	0.0854	0.2807	0.6312	0.8848	0.9587	(94)
Useful gains	1487.3348	1802.7164	1949.2328	1769.3668	1236.1136	635.5172	230.4905	271.0162	794.5506	1391.6659	1508.9753	1385.0549	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2660.4195	2626.8831	2328.9815	1867.6239	1250.0180	635.9862	230.4941	271.0265	797.7244	1509.7232	2152.6551	2627.8353	(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													
	872.7750	553.8400	282.5331	70.7451	10.3449	0.0000	0.0000	0.0000	0.0000	87.8346	463.4495	924.6286	(98)
Space heating												3266.1509	(98)
RHI space heating demand												3266	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(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	0.4141	0.4059	0.3978	0.3572	0.3491	0.3085	0.3085	0.3004	0.3247	0.3491	0.3653	0.3816	(22b)
Effective ac	0.5857	0.5824	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5728	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	76.4904	76.0558	75.6297	73.6284	73.2539	71.5109	71.5109	71.1881	72.1823	73.2539	74.0114	74.8033	(38)
Heat transfer coeff	209.6897	209.2550	208.8289	206.8276	206.4532	204.7101	204.7101	204.3873	205.3815	206.4532	207.2107	208.0026	(39)
Average = Sum(39)m / 12 =												206.8258	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5414	1.5382	1.5351	1.5203	1.5176	1.5048	1.5048	1.5024	1.5097	1.5176	1.5232	1.5290	(40)
HLP (average)												1.5203	(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	2.9091	(42)
Average daily hot water use (litres/day)	103.2920	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:		
Store volume	230.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.8050	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.0287	(55)
Total storage loss		

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	76.4402	67.8935	55.2147	41.8011	31.2468	26.3799	28.5044	37.0511	49.7298	63.1435	73.6977	78.5647	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	782.6118	776.4008	746.8687	701.3886	654.4860	613.4092	590.2231	600.7542	627.7142	673.4302	723.8321	762.2837	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1517.2286	2072.1767	2611.1205	3120.6348	3432.4141	3392.7866	3261.4990	3006.7329	2687.4740	2132.7440	1612.4774	1384.9537	(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	45.0533	45.1469	45.2391	45.6768	45.7596	46.1493	46.1493	46.2222	45.9984	45.7596	45.5924	45.4188	
alpha	4.0036	4.0098	4.0159	4.0451	4.0506	4.0766	4.0766	4.0815	4.0666	4.0506	4.0395	4.0279	
util living area													
	0.9798	0.9399	0.8551	0.7051	0.5346	0.3812	0.2751	0.3108	0.5081	0.8047	0.9553	0.9853	(86)
MIT	19.7013	20.0836	20.4871	20.8045	20.9450	20.9891	20.9978	20.9963	20.9665	20.7212	20.1339	19.6246	(87)
Th 2	19.6566	19.6590	19.6613	19.6723	19.6743	19.6839	19.6839	19.6857	19.6802	19.6743	19.6702	19.6658	(88)
util rest of house													
	0.9734	0.9232	0.8206	0.6500	0.4666	0.3050	0.1934	0.2230	0.4187	0.7469	0.9397	0.9806	(89)
MIT 2	18.0112	18.5490	19.0890	19.4833	19.6319	19.6784	19.6833	19.6846	19.6605	19.4086	18.6388	17.9077	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.5174	19.0085	19.5077	19.8789	20.0251	20.0709	20.0770	20.0774	20.0516	19.8017	19.0865	18.4219	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3674	18.8585	19.3577	19.7289	19.8751	19.9209	19.9270	19.9274	19.9016	19.6517	18.9365	18.2719	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9648	0.9106	0.8117	0.6525	0.4772	0.3189	0.2085	0.2392	0.4342	0.7458	0.9284	0.9735	(94)
Useful gains	1463.8615	1887.0078	2119.3224	2036.2886	1638.0231	1082.0178	680.1530	719.3484	1166.8615	1590.6077	1497.0310	1348.2845	(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													
	2949.7819	2920.8917	2685.0493	2239.7239	1687.7843	1089.2420	681.0620	720.9624	1191.5407	1868.7438	2452.6542	2926.9822	(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													
	1105.5248	694.7700	420.9008	146.4734	37.0224	0.0000	0.0000	0.0000	0.0000	206.9333	688.0487	1174.5511	(98)
Space heating												4474.2245	(98)
Space heating per m2											(98) / (4) =	32.8890	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1924.2752	1514.8549	1553.3438	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9686	0.9839	0.9768	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1863.8770	1490.4247	1517.3698	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3815.9868	3668.8158	3376.1465	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1405.5191	1620.7230	1382.9299	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4409.1720 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	353.9627	408.1591	348.2739	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1110.3957 (107)
Space cooling per m2 8.1623 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4922.1391 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1105.5248	694.7700	420.9008	146.4734	37.0224	0.0000	0.0000	0.0000	0.0000	206.9333	688.0487	1174.5511	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	1216.1989	764.3234	463.0372	161.1368	40.7287	0.0000	0.0000	0.0000	0.0000	227.6493	756.9293	1292.1355	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 80.8000 (216)

(217)m	89.0275	88.4556	87.2999	84.9594	82.3440	80.8000	80.8000	80.8000	80.8000	85.7311	88.3771	89.1532	(217)

Fuel for water heating, kWh/month

251.2134	222.9177	237.3694	218.8719	221.4674	201.9160	194.1521	212.7234	212.2469	224.9039	230.4218	244.8959	(219)

Water heating fuel used 2673.1000 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	88.4907	102.0398	87.0685	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 277.5989 (221)
Annual totals kWh/year
Space heating fuel - main system 4922.1391 (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) 539.9829 (232)
Total delivered energy for all uses 8487.8210 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4922.1391	3.4800	171.2904	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2673.1000	3.4800	93.0239	(247)
Space cooling	277.5989	13.1900	36.6153	(248)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	539.9829	13.1900	71.2237	(250)
Additional standing charges			120.0000	(251)
Total energy cost			502.0459	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.1647 (257)
SAP value 83.7523
SAP rating (Section 12) 84 (258)
SAP band B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4922.1391	0.2160	1063.1821	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2673.1000	0.2160	577.3896	(264)
Space and water heating			1640.5717	(265)
Space cooling	277.5989	0.5190	144.0738	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	539.9829	0.5190	280.2511	(268)
Total kg/year			2103.8216	(272)
CO2 emissions per m2			15.4600	(273)
EI value			84.4282	
EI rating			84	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.00) / 0.9090 = 3.828, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.00) / 0.9090 = 0.2376, stars = 4
Water heating energy efficiency 3.48 / 0.8488 = 4.100, stars = 4
Water heating environmental impact 0.216 / 0.8488 = 0.2545, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3410	0.3247	0.3166	0.3004	0.3004	0.2598	0.2760	0.2679	0.2598	0.2760	0.2760	0.3085	(22b)
Effective ac	0.5581	0.5527	0.5501	0.5451	0.5451	0.5337	0.5381	0.5359	0.5337	0.5381	0.5381	0.5476	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	72.8881	72.1823	71.8423	71.1881	71.1881	69.7033	70.2714	69.9830	69.7033	70.2714	70.2714	71.5109	(38)
Heat transfer coeff	206.0874	205.3815	205.0415	204.3873	204.3873	202.9025	203.4706	203.1823	202.9025	203.4706	203.4706	204.7101	(39)

Average = Sum(39)m / 12 = 204.1162 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5149	1.5097	1.5072	1.5024	1.5024	1.4915	1.4957	1.4935	1.4915	1.4957	1.4957	1.5048	(40)
HLP (average)												1.5004	(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	2.9091	(42)
Average daily hot water use (litres/day)	103.2920	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:		
Store volume	230.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.8050	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.0287	(55)
Total storage loss		

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	76.4402	67.8935	55.2147	41.8011	31.2468	26.3799	28.5044	37.0511	49.7298	63.1435	73.6977	78.5647	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	782.6118	776.4008	746.8687	701.3886	654.4860	613.4092	590.2231	600.7542	627.7142	673.4302	723.8321	762.2837	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834	(83)
Total gains	1568.4413	2021.0470	2546.5429	3134.7445	3364.1438	3511.9879	3381.1233	3174.5675	2830.3542	2204.8554	1705.4956	1444.6671	(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	45.8409	45.9984	46.0747	46.2222	46.2222	46.5604	46.4304	46.4963	46.5604	46.4304	46.4304	46.1493	
alpha	4.0561	4.0666	4.0716	4.0815	4.0815	4.1040	4.0954	4.0998	4.1040	4.0954	4.0954	4.0766	
util living area													
	0.9689	0.9256	0.8147	0.6215	0.4289	0.2421	0.1324	0.1535	0.3550	0.7018	0.9228	0.9760	(86)
MIT	19.9559	20.2560	20.6437	20.8982	20.9813	20.9987	20.9999	20.9999	20.9937	20.8685	20.3968	19.8966	(87)
Th 2	19.6763	19.6802	19.6821	19.6857	19.6857	19.6939	19.6908	19.6923	19.6939	19.6908	19.6908	19.6839	(88)
util rest of house													
	0.9585	0.9039	0.7701	0.5566	0.3541	0.1671	0.0536	0.0699	0.2640	0.6227	0.8955	0.9678	(89)
MIT 2	18.3903	18.8061	19.3088	19.5984	19.6746	19.6936	19.6907	19.6923	19.6916	19.5857	19.0163	18.3124	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8592	19.2403	19.7086	19.9877	20.0659	20.0844	20.0828	20.0839	20.0816	19.9699	19.4297	18.7869	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7092	19.0903	19.5586	19.8377	19.9159	19.9344	19.9328	19.9339	19.9316	19.8199	19.2797	18.6369	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9483	0.8920	0.7654	0.5644	0.3674	0.1810	0.0682	0.0854	0.2807	0.6312	0.8848	0.9587	(94)
Useful gains	1487.3348	1802.7164	1949.2328	1769.3668	1236.1136	635.5172	230.4905	271.0162	794.5506	1391.6659	1508.9753	1385.0549	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2660.4195	2626.8831	2328.9815	1867.6239	1250.0180	635.9862	230.4941	271.0265	797.7244	1509.7232	2152.6551	2627.8353	(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													
	872.7750	553.8400	282.5331	70.7451	10.3449	0.0000	0.0000	0.0000	0.0000	87.8346	463.4495	924.6286	(98)
Space heating												3266.1509	(98)
Space heating per m2											(98) / (4) =	24.0088	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1460.8980	1058.0472	1097.1842	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9893	0.9962	0.9945	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1445.3071	1054.0034	1091.1363	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3952.7303	3806.0537	3569.0884	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1805.3447	2047.5254	1843.5964	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 5696.4665 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	454.6539	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 454.6539 (107)
Space cooling per m2 3.3421 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3593.1253 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	872.7750	553.8400	282.5331	70.7451	10.3449	0.0000	0.0000	0.0000	0.0000	87.8346	463.4495	924.6286	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	960.1485	609.2849	310.8175	77.8274	11.3806	0.0000	0.0000	0.0000	0.0000	96.6277	509.8454	1017.1932	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 80.8000 (216)

(217)m 88.6399	88.0115	86.3339	83.3524	81.2848	80.8000	80.8000	80.8000	80.8000	83.7110	87.5589	88.7801 (217)

Fuel for water heating, kWh/month

252.3120	224.0426	240.0255	223.0917	224.3532	201.9160	194.1521	212.7234	212.2469	230.3311	232.5750	245.9249	(219)

Water heating fuel used 2693.6944 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	113.6635	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 113.6635 (221)
Annual totals kWh/year
Space heating fuel - main system 3593.1253 (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) 539.9829 (232)
Total delivered energy for all uses 7015.4661 (238)

10a. Fuel costs - using BEDF prices (374)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3593.1253	4.1800	150.1926	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2693.6944	4.1800	112.5964	(247)
Space cooling	113.6635	14.8100	16.8336	(248)
Pumps and fans for heating	75.0000	14.8100	11.1075	(249)
Energy for lighting	539.9829	14.8100	79.9715	(250)
Additional standing charges			109.0000	(251)
Total energy cost			479.7016	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3593.1253	0.2160	776.1151	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2693.6944	0.2160	581.8380	(264)
Space and water heating			1357.9531	(265)
Space cooling	113.6635	0.5190	58.9913	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	539.9829	0.5190	280.2511	(268)
Total kg/year			1736.1205	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3593.1253	1.2200	4383.6128	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2693.6944	1.2200	3286.3072	(264)
Space and water heating			7669.9200	(265)
Space cooling	113.6635	3.0700	348.9468	(266)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	539.9829	3.0700	1657.7476	(268)
Primary energy kWh/year			9906.8644	(272)
Primary energy kWh/m2/year			72.8232	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 84

(For testing purposes):

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

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

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

Fuel prices for cost data on this page from database revision number 374 TEST (25 Feb 2015)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£108	£108	£0
Mains gas	£372	£372	£0
Space heating	£270	£270	£0
Space cooling	£17	£17	£0
Water heating	£113	£113	£0
Lighting	£80	£80	£0
Total cost of fuels	£480	£480	£0
Total cost of uses	£480	£480	£0
Delivered energy	52 kWh/m²	52 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.7 tonnes	1.7 tonnes	0.0 tonnes
CO2 emissions per m²	13 kg/m²	13 kg/m²	0 kg/m²
Primary energy	73 kWh/m²	73 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1044.74 (P1)
Transmission heat loss coefficient	133.20 (37)
Summer heat loss coefficient	1177.94 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
East	1.000	1.00	1.000	1.000 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
South	31.9300	112.2060	0.6300	0.7000	0.9000	1279.7897
West	13.6400	117.5071	0.6300	0.7000	0.9000	572.5349
East	5.4400	117.5071	0.6300	0.7000	0.9000	228.3424
West	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
East	3.5500	203.0000	0.5700	0.7000	1.0000	258.7854
total:						3253.6613

	Jun	Jul	Aug	
Solar gains	3424	3254	2992	(P3)
Internal gains	610	587	598	
Total summer gains	4034	3841	3590	(P5)
Summer gain/loss ratio	3.42	3.26	3.05	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.67	21.41	21.10	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 23000 3 Bed Penthouse Duplex
Survey Reference: Penthouse - Be Clean
Property: London, EC1N 8JR

Issued on Date: 25.Mar.2015
Prop Type Ref:

SAP Rating:	84 B	**CO2 Emissions (t/year):**	1.68	**DER:**	15.97 Pass	**TER:**	16.15	**Percentage DER<TER:**	1.10 %
Environmental:	85 B	**General Requirements Compliance:**	Pass	**DFEE:**	48.52 Pass	**TFEE:**	55.75	**Percentage DFEE<TFEE:**	12.96 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: admin Admin, Tel: 4, Fax: s@l.f Surveyor ID: Admin
Address:
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 2.02r19
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Penthouse - Be Clean'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Flat)     25/03/2015

FullRefNo:                    Penthouse - Be Clean

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     EC1N 8JR
DwellingOrientation:          North
Property Type:                Flat, End-Terrace
Storeys:                      2
Date Built:                   2015
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              39.29, 69.8, 2.87
    2nd Storey:              30.57, 66.24, 2.95
Living Area:                  40.74 m2, fraction: 29.9%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Medium
Thermal MassValue:            250
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               77.23, 150.02, 150, Other, Cavity, 0, 0.11, Gross
Shelter Wall                  50.19, 51.95, 18, Other, Cavity, 0.43, 0.105031987014227, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  44.61, 110, PartyWallSinglePlasterLightweight, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Penthouse GF Roof        16.89, 16.89, 0, Other, 0.11
    Penthouse FF Roof        66.63, 70.18, 0, Other, 0.11
Heat Loss Floors              Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            69.8, 30
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                Manufacturer, Door to Corridor, , , , , , ,
    French Doors             Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Skylight                 Manufacturer, Roof Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Flat Door                Door to Corridor, Shelter Wall, North, , , , , 0, 0, 0, 1.76,
    Front French Doors       Window, External Wall 1, East, , None, 0, , 0, 0, 0, 5.44,
    Front Windows            Window, External Wall 1, East, , None, 0, , 0, 0, 0, 10.89,
    Side Windows             Window, External Wall 1, South, , None, 0, , 0, 0, 0, 31.93,
    Rear Windows             Window, External Wall 1, West, , None, 0, , 0, 0, 0, 13.64,
    Rear French Door         Window, External Wall 1, West, , None, 0, , 0, 0, 0, 10.89,
    Skylight Door            Roof Window, Penthouse FF Roof, East, 0, None, , , 0, 0, 0, 3.55,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.071
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 28.88, 0.3, 0.3, 8.66,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 28.08, 0.04, 0.04, 1.12,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 69.88, 0.05, 0.05, 3.49,
    3.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 30.57, 0.07, 0.07, 2.14,
    4.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 39.29, 0.07, 0.07, 2.75,
    5.                       External wall, E16 Corner (normal), Table K1 - Approved, Yes, 11.64, 0.09, 0.09, 1.05,
    6.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 11.64, 0.06, 0.06, 0.70,
    7.                       External roof, R1 Head of roof window, Table K1 - Default, Yes, 2.45, 0.08, 0.08, 0.20,
    8.                       External roof, R2 Sill of roof window, Table K1 - Default, Yes, 2.45, 0.06, 0.06, 0.15,
    9.                       External roof, R3 Jamb of roof window, Table K1 - Default, Yes, 2.9, 0.08, 0.08, 0.23,
Pressure Test:                True
Designed q50:                 4
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System
    Cooled Area              137.04
```

```
    Data Source              SAP table
    Type                     Split or Multi-Split
    Class                    A
    Control                  On/Off
Light Fittings:               16
LEL Fittings:                 16
Percentage of LEL Fittings:   100
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
    MHS                      Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                 102
    Boiler Efficiency Type   Sedbuk 2009
    Efficiency               91
    Model Name               tbc
    Manufacturer             tbc
    Controls by PCDF         0
    MHS Controls             CBI Time and temperature zone control
    Boiler Interlock         Yes
    Compensator              0
    Delayed Start Stat       Yes
    Ctrl SAP Code            2110
    Burner Control           OnOff
    Flue Type                Balanced
    Fan Assisted Flue        Yes
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Radiators
    Flow Temperature         Normal (> 45°C)
Main Heating 2                None
Heating Systems Interaction   Each system heats separate parts of dwelling
Smoke Control Area            Unknown
Community Heating             None
Secondary Heating             None
Water Heating
    Type                     MainHeating1
    WHS                      HWP From main heating 1
    Low Water Usage          Yes
    SAP Code                 901
    Showers in Property      Non-electric only
    Hot Water Cylinder
    Cylinder Type            HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume          230.00
    Cylinder Stat            Yes
    Pipeworks Insulated      Fully insulated primary pipework
    Cylinder in Heated Space Yes
    Separate Time Control    Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit                       None
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None


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

DWELLING AS DESIGNED

Top-floor flat, total floor area 136 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.15 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.97 kg/m²OK
-------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)48.5 kWh/m²OK
-------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.11 (max. 0.30)        0.11 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.11 (max. 0.20)        0.11 (max. 0.35)          OK
Openings        1.20 (max. 2.00)        1.70 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         4.00 (design value)
Maximum                                 10.0                                            OK
-------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 91.0% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 1.91 kWh/day
Permitted by DBSCG 2.43                         OK
Primary pipework insulated:             Yes                                             OK
-------------------------------------------------------------------------------------------------
```

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

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

Minimum	75%	OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	16.33 m^2, No overhang	
Windows facing South:	31.93 m^2, No overhang	
Windows facing West:	24.53 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

---

10 Key features

External wall U-value	0.11 W/m^2K
External wall U-value	0.11 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Roof U-value	0.11 W/m^2K
Roof window U-value	1.00 W/m^2K

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(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	0.3551	0.3481	0.3412	0.3063	0.2994	0.2646	0.2646	0.2576	0.2785	0.2994	0.3133	0.3272	(22b)
Effective ac	0.5630	0.5606	0.5582	0.5469	0.5448	0.5350	0.5350	0.5332	0.5388	0.5448	0.5491	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	73.5289	73.2092	72.8959	71.4240	71.1487	69.8667	69.8667	69.6293	70.3605	71.1487	71.7058	72.2882	(38)
Heat transfer coeff	206.7282	206.4085	206.0951	204.6233	204.3479	203.0660	203.0660	202.8286	203.5598	204.3479	204.9050	205.4874	(39)

Average = Sum(39)m / 12 = 204.6220 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5196	1.5173	1.5150	1.5041	1.5021	1.4927	1.4927	1.4909	1.4963	1.5021	1.5062	1.5105	(40)
HLP (average)												1.5041	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	536.2845	534.0232	516.5884	488.1117	458.5625	430.5393	412.6094	419.1908	434.0535	462.7661	495.8146	521.2125	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1270.9013	1829.7991	2380.8402	2907.3579	3236.4905	3209.9168	3083.8853	2825.1695	2493.8133	1922.0799	1384.4599	1143.8826	(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	45.6988	45.7695	45.8391	46.1689	46.2311	46.5229	46.5229	46.5774	46.4101	46.2311	46.1054	45.9747	
alpha	4.0466	4.0513	4.0559	4.0779	4.0821	4.1015	4.1015	4.1052	4.0940	4.0821	4.0737	4.0650	
util living area													
	0.9889	0.9579	0.8816	0.7339	0.5576	0.3989	0.2884	0.3279	0.5384	0.8414	0.9721	0.9925	(86)
MIT	19.5798	19.9838	20.4243	20.7781	20.9379	20.9876	20.9974	20.9957	20.9599	20.6704	20.0260	19.4991	(87)
Th 2	19.6728	19.6746	19.6763	19.6844	19.6859	19.6930	19.6930	19.6943	19.6903	19.6859	19.6828	19.6796	(88)
util rest of house													
	0.9851	0.9454	0.8512	0.6802	0.4885	0.3201	0.2034	0.2360	0.4461	0.7891	0.9616	0.9899	(89)
MIT 2	17.8483	18.4238	19.0230	19.4666	19.6374	19.6866	19.6923	19.6930	19.6661	19.3629	18.4988	17.7360	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.3668	18.8910	19.4426	19.8594	20.0269	20.0762	20.0831	20.0831	20.0536	19.7544	18.9561	18.2639	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2168	18.7410	19.2926	19.7094	19.8769	19.9262	19.9331	19.9331	19.9036	19.6044	18.8061	18.1139	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9792	0.9339	0.8409	0.6813	0.4989	0.3344	0.2191	0.2530	0.4618	0.7853	0.9520	0.9854	(94)
Useful gains	1244.4654	1708.8573	2001.9787	1980.6554	1614.5842	1073.2542	675.7960	714.6970	1151.5196	1509.4660	1317.9830	1127.1555	(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													
	2876.9977	2856.8916	2636.5001	2211.8451	1670.9331	1081.5635	676.8474	716.6154	1181.3704	1840.0359	2398.6482	2859.1413	(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													
	1214.6040	771.4791	472.0839	166.4566	41.9236	0.0000	0.0000	0.0000	0.0000	245.9440	778.0790	1288.5975	(98)
Space heating												4979.1676	(98)
Space heating per m2											(98) / (4) =	36.6008	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1908.8203	1502.6883	1541.4973	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9699	0.9846	0.9778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1851.3309	1479.5710	1507.2090	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3813.0557	3665.6487	3372.0298	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1412.4419	1626.4417	1387.4266	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4426.3103 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	355.7061	409.5993	349.4063	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1114.7118 (107)
Space cooling per m2 8.1940 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5418.0278 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1214.6040	771.4791	472.0839	166.4566	41.9236	0.0000	0.0000	0.0000	0.0000	245.9440	778.0790	1288.5975	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	1321.6583	839.4767	513.6930	181.1279	45.6187	0.0000	0.0000	0.0000	0.0000	267.6213	846.6583	1402.1735	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m	90.1688	89.6468	88.5642	86.2788	83.5156	81.8000	81.8000	81.8000	81.8000	87.1701	89.6050	90.2849	(217)

Fuel for water heating, kWh/month

	248.0339	219.9558	233.9808	215.5248	218.3604	199.4476	191.7786	210.1229	209.6522	221.1910	227.2641	241.8262	(219)

Water heating fuel used 2637.1384 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	88.9265	102.3998	87.3516	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 278.6779 (221)
Annual totals kWh/year
Space heating fuel - main system 5418.0278 (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) 479.9848 (232)
Total delivered energy for all uses 8888.8290 (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	5418.0278	0.2160	1170.2940	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2637.1384	0.2160	569.6219	(264)
Space and water heating			1739.9159	(265)
Space cooling	278.6779	0.5190	144.6339	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Total CO2, kg/year			2172.5869	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9700	(273)

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

DER		15.9700	ZC1
Total Floor Area	TFA	136.0400	
Assumed number of occupants	N	2.9091	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.2796	ZC2
CO2 emissions from cooking, equation (L16)		1.3880	ZC3
Total CO2 emissions		30.6375	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		30.6375	ZC8

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		395.7340	(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) =	0.1011 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3511 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247 (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	0.4141	0.4059	0.3978	0.3572	0.3491	0.3085	0.3085	0.3004	0.3247	0.3491	0.3653	0.3816	(22b)
Effective ac	0.5857	0.5824	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5728	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8811			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4133	(36)
Total fabric heat loss					(33) + (36) =		97.2944	(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	76.4904	76.0558	75.6297	73.6284	73.2539	71.5109	71.5109	71.1881	72.1823	73.2539	74.0114	74.8033	(38)
Heat transfer coeff	173.7849	173.3502	172.9241	170.9228	170.5484	168.8053	168.8053	168.4825	169.4767	170.5484	171.3058	172.0977	(39)
Average = Sum(39)m / 12 =												170.9210	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2775	1.2743	1.2711	1.2564	1.2537	1.2409	1.2409	1.2385	1.2458	1.2537	1.2592	1.2651	(40)
HLP (average)												1.2564	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)
Water storage loss:													
Store volume												230.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7973	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9706	(55)
Total storage loss	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(56)
If cylinder contains dedicated solar storage	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(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													

	221.8465	195.5552	205.4207	184.2079	180.5625	161.4037	155.0724	170.0780	169.7511	191.0099	201.8957	216.5299	(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													
	221.8465	195.5552	205.4207	184.2079	180.5625	161.4037	155.0724	170.0780	169.7511	191.0099	201.8957	216.5299	(64)
								Total per year (kWh/year) = Sum(64)m =				2253.3335	(64)
Heat gains from water heating, kWh/month													
	98.7049	87.5494	93.2433	85.3855	84.9780	77.8031	76.5025	81.4919	80.5786	88.4518	91.2667	96.9371	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	132.6679	130.2819	125.3270	118.5910	114.2177	108.0599	102.8260	109.5321	111.9148	118.8868	126.7593	130.2918	(72)
Total internal gains													
	534.3463	532.0850	514.6502	486.1735	456.6242	428.6011	410.6711	417.2526	432.1153	460.8279	493.8764	519.2743	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	6.9000	19.6403	0.6300	0.7000	0.7700	41.4160	(76)
South	13.4900	46.7521	0.6300	0.7000	0.7700	192.7456	(78)
West	10.3500	19.6403	0.6300	0.7000	0.7700	62.1240	(80)
East	1.5000	26.0000	0.6300	0.7000	1.0000	15.4791	(82)

Solar gains	311.7648	550.3628	792.8231	1030.2524	1184.0933	1185.1493	1138.8752	1025.0351	876.4607	620.1085	377.2181	264.1986	(83)
Total gains	846.1111	1082.4478	1307.4732	1516.4259	1640.7175	1613.7503	1549.5463	1442.2876	1308.5760	1080.9364	871.0945	783.4729	(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	54.3616	54.4979	54.6322	55.2719	55.3932	55.9652	55.9652	56.0724	55.7435	55.3932	55.1483	54.8945	
alpha	4.6241	4.6332	4.6421	4.6848	4.6929	4.7310	4.7310	4.7382	4.7162	4.6929	4.6766	4.6596	
util living area													
	0.9976	0.9924	0.9761	0.9248	0.8101	0.6326	0.4715	0.5239	0.7757	0.9593	0.9942	0.9983	(86)
MIT	19.6114	19.8411	20.1684	20.5491	20.8259	20.9596	20.9918	20.9868	20.8953	20.5008	19.9745	19.5739	(87)
Th 2	19.8585	19.8611	19.8635	19.8751	19.8773	19.8875	19.8875	19.8893	19.8835	19.8773	19.8729	19.8683	(88)
util rest of house													
	0.9968	0.9898	0.9678	0.8992	0.7515	0.5376	0.3563	0.4042	0.6895	0.9402	0.9918	0.9978	(89)
MIT 2	18.0201	18.3560	18.8293	19.3669	19.7169	19.8625	19.8847	19.8844	19.8061	19.3156	18.5602	17.9720	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.4966	18.8008	19.2303	19.7209	20.0490	20.1911	20.2162	20.2145	20.1323	19.6706	18.9837	18.4517	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4966	18.8008	19.2303	19.7209	20.0490	20.1911	20.2162	20.2145	20.1323	19.6706	18.9837	18.4517	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9863	0.9618	0.8950	0.7614	0.5647	0.3910	0.4402	0.7107	0.9356	0.9891	0.9967	(94)
Useful gains	842.1580	1067.6596	1257.5511	1357.2120	1249.1772	911.3308	605.9084	634.8691	930.0076	1011.3400	861.6102	780.8536	(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													
	2467.1610	2409.6986	2201.3738	1849.5459	1423.9072	943.8046	610.4401	642.6795	1022.3354	1546.9708	2035.7533	2452.6857	(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													
	1209.0022	901.8502	702.2041	354.4804	129.9991	0.0000	0.0000	0.0000	0.0000	398.5093	845.3830	1243.8431	(98)
Space heating												5785.2715	(98)
Space heating per m2											(98) / (4) =	42.5263	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												6187.4562	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1209.0022	901.8502	702.2041	354.4804	129.9991	0.0000	0.0000	0.0000	0.0000	398.5093	845.3830	1243.8431	(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)
1293.0505 964.5457 751.0204 379.1235 139.0365 0.0000 0.0000 0.0000 0.0000 426.2132 904.1530 1330.3134 (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
221.8465 195.5552 205.4207 184.2079 180.5625 161.4037 155.0724 170.0780 169.7511 191.0099 201.8957 216.5299 (64)
Efficiency of water heater 79.8000 (216)
(217)m 88.6569 88.3881 87.8345 86.5324 83.9550 79.8000 79.8000 79.8000 79.8000 86.7319 88.2196 88.7359 (217)
Fuel for water heating, kWh/month
250.2304 221.2461 233.8725 212.8774 215.0705 202.2603 194.3263 213.1303 212.7207 220.2302 228.8558 244.0162 (219)
Water heating fuel used 2648.8369 (219)
Annual totals kWh/year
Space heating fuel - main system 6187.4562 (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) 479.9848 (232)
Total delivered energy for all uses 9391.2779 (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	6187.4562	0.2160	1336.4905 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2648.8369	0.2160	572.1488 (264)
Space and water heating			1908.6393 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	479.9848	0.5190	249.1121 (268)
Total CO2, kg/m2/year			2196.6764 (272)
Emissions per m2 for space and water heating			14.0300 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8312 (272b)
Emissions per m2 for pumps and fans			0.2861 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0300 * 1.00) + 1.8312 + 0.2861, rounded to 2 d.p.			16.1500 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(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) =	0.2559	(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	0.3263	0.3199	0.3135	0.2815	0.2751	0.2431	0.2431	0.2367	0.2559	0.2751	0.2879	0.3007	(22b)
Effective ac	0.5532	0.5512	0.5491	0.5396	0.5378	0.5296	0.5296	0.5280	0.5327	0.5378	0.5414	0.5452	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		20.4924 (36)
Total fabric heat loss	(33) + (36) =	133.1992 (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	72.2480	71.9781	71.7135	70.4706	70.2381	69.1556	69.1556	68.9551	69.5726	70.2381	70.7085	71.2003	(38)
Heat transfer coeff	205.4473	205.1773	204.9127	203.6699	203.4373	202.3548	202.3548	202.1544	202.7718	203.4373	203.9077	204.3995	(39)
Average = Sum(39)m / 12 =												203.6687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5102	1.5082	1.5063	1.4971	1.4954	1.4875	1.4875	1.4860	1.4905	1.4954	1.4989	1.5025	(40)
HLP (average)												1.4971	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)
Total internal gains													
	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1181.4210	1741.1799	2294.0092	2822.9579	3153.6689	3129.3175	3005.1750	2744.0390	2411.8228	1837.5732	1297.1120	1055.2598	(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	45.9837	46.0442	46.1036	46.3850	46.4380	46.6864	46.6864	46.7327	46.5904	46.4380	46.3309	46.2194	
alpha	4.0656	4.0696	4.0736	4.0923	4.0959	4.1124	4.1124	4.1155	4.1060	4.0959	4.0887	4.0813	
util living area													
	0.9914	0.9637	0.8913	0.7456	0.5680	0.4073	0.2949	0.3363	0.5524	0.8560	0.9774	0.9944	(86)
MIT	19.5360	19.9466	20.3993	20.7665	20.9345	20.9867	20.9973	20.9953	20.9565	20.6474	19.9831	19.4531	(87)
Th 2	19.6799	19.6813	19.6828	19.6897	19.6909	19.6969	19.6969	19.6980	19.6946	19.6909	19.6883	19.6856	(88)
util rest of house													
	0.9884	0.9526	0.8625	0.6926	0.4983	0.3273	0.2083	0.2424	0.4589	0.8063	0.9687	0.9924	(89)
MIT 2	18.3894	18.7908	19.2143	19.5323	19.6558	19.6922	19.6964	19.6970	19.6766	19.4521	18.8378	18.3117	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.7327	19.1370	19.5692	19.9019	20.0388	20.0799	20.0860	20.0858	20.0599	19.8101	19.1808	18.6535	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7327	19.1370	19.5692	19.9019	20.0388	20.0799	20.0860	20.0858	20.0599	19.8101	19.1808	18.6535	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9856	0.9470	0.8597	0.7018	0.5174	0.3511	0.2343	0.2706	0.4860	0.8115	0.9642	0.9903	(94)
Useful gains	1164.3984	1648.8332	1972.1277	1981.0721	1631.8306	1098.7859	704.0097	742.5683	1172.1023	1491.1927	1250.7398	1045.0493	(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													
	2965.1680	2921.1016	2678.0366	2240.7519	1696.4160	1108.8815	705.4029	745.1099	1208.4938	1873.6706	2463.3614	2954.2898	(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													
	1339.7726	854.9644	525.1962	186.9695	48.0516	0.0000	0.0000	0.0000	0.0000	284.5636	873.0875	1420.4749	(98)
Space heating												5533.0803	(98)
Space heating per m2											(98) / (4) =	40.6725	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1902.1356	1497.4259	1536.3734	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9684	0.9838	0.9764	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1842.0486	1473.2008	1500.1121	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3735.4565	3589.9383	3293.8992	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	1363.2537	1574.8527	1334.5776	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												4272.6840	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	340.8134	393.7132	333.6444	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												1068.1710	(107)
Space cooling per m2												7.8519	(108)
Energy for space heating												40.6725	(99)
Energy for space cooling												7.8519	(108)
Total												48.5243	(109)

Dwelling Fabric Energy Efficiency (DFEE) 48.5 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(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) =	0.2984	(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	0.3805	0.3730	0.3656	0.3283	0.3208	0.2835	0.2835	0.2760	0.2984	0.3208	0.3357	0.3506	(22b)
Effective ac	0.5724	0.5696	0.5668	0.5539	0.5515	0.5402	0.5402	0.5381	0.5445	0.5515	0.5564	0.5615	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8811			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4133	(36)
Total fabric heat loss (33) + (36) =	97.2944	(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	74.7487	74.3817	74.0219	72.3320	72.0158	70.5439	70.5439	70.2714	71.1109	72.0158	72.6554	73.3241	(38)
Heat transfer coeff	172.0432	171.6761	171.3163	169.6264	169.3102	167.8384	167.8384	167.5658	168.4053	169.3102	169.9498	170.6185	(39)
Average = Sum(39)m / 12 =												169.6249	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2647	1.2620	1.2593	1.2469	1.2446	1.2337	1.2337	1.2317	1.2379	1.2446	1.2493	1.2542	(40)
HLP (average)												1.2469	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)

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

	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)

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

	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)

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

	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)

	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)

Water heating gains (Table 5)

	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)

Total internal gains

	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	6.9000	19.6403	0.6300	0.7000	0.7700	41.4160	(76)
South	13.4900	46.7521	0.6300	0.7000	0.7700	192.7456	(78)
West	10.3500	19.6403	0.6300	0.7000	0.7700	62.1240	(80)
East	1.5000	26.0000	0.6300	0.7000	1.0000	15.4791	(82)

Solar gains	311.7648	550.3628	792.8231	1030.2524	1184.0933	1185.1493	1138.8752	1025.0351	876.4607	620.1085	377.2181	264.1986	(83)
Total gains	758.5690	995.7668	1222.5805	1433.9642	1559.8341	1535.0893	1472.7742	1363.0953	1228.5237	998.3679	785.6848	696.7883	(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	54.9119	55.0293	55.1449	55.6943	55.7983	56.2876	56.2876	56.3792	56.0981	55.7983	55.5883	55.3704	
alpha	4.6608	4.6686	4.6763	4.7130	4.7199	4.7525	4.7525	4.7586	4.7399	4.7199	4.7059	4.6914	
util living area	0.9985	0.9945	0.9812	0.9362	0.8290	0.6556	0.4918	0.5485	0.8020	0.9691	0.9962	0.9990	(86)
MIT	19.5693	19.8000	20.1306	20.5183	20.8090	20.9539	20.9904	20.9843	20.8799	20.4616	19.9289	19.5296	(87)
Th 2	19.8686	19.8708	19.8728	19.8827	19.8845	19.8931	19.8931	19.8947	19.8898	19.8845	19.8808	19.8769	(88)
util rest of house	0.9980	0.9926	0.9745	0.9135	0.7731	0.5598	0.3731	0.4252	0.7191	0.9537	0.9947	0.9987	(89)
MIT 2	18.5693	18.8007	19.1286	19.5076	19.7624	19.8733	19.8909	19.8906	19.8276	19.4639	18.9378	18.5362	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9909	0.9712	0.9118	0.7837	0.5875	0.4089	0.4625	0.7402	0.9516	0.9934	0.9982	(94)
Useful gains	756.5520	986.6987	1187.3531	1307.4891	1222.4544	901.8294	602.2556	630.3827	909.3499	950.0377	780.4790	695.5266	(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	2506.4566	2437.7894	2214.8905	1850.6658	1418.1177	939.3799	607.5992	639.7860	1017.6257	1551.3329	2062.2771	2496.7788	(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	1301.9290	975.1329	764.4878	391.0872	145.5735	0.0000	0.0000	0.0000	0.0000	447.3637	922.8946	1340.1317	(98)
Space heating												6288.6004	(98)
Space heating per m2											(98) / (4) =	46.2261	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1577.6805	1242.0038	1273.5000	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8924	0.9419	0.9214	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1407.9716	1169.8909	1173.3894	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1895.0155	1820.5013	1697.8191	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	350.6716	484.0542	390.1757	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1224.9015	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	87.6679	121.0135	97.5439	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												306.2254	(107)
Space cooling per m2												2.2510	(108)
Energy for space heating												46.2261	(99)
Energy for space cooling												2.2510	(108)
Total												48.4771	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.2924	0.2785	0.2715	0.2576	0.2576	0.2228	0.2367	0.2298	0.2228	0.2367	0.2367	0.2646	(22b)
Effective ac	0.5428	0.5388	0.5369	0.5332	0.5332	0.5248	0.5280	0.5264	0.5248	0.5280	0.5280	0.5350	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	70.8796	70.3605	70.1105	69.6293	69.6293	68.5373	68.9551	68.7431	68.5373	68.9551	68.9551	69.8667	(38)
Heat transfer coeff	204.0789	203.5598	203.3097	202.8286	202.8286	201.7366	202.1544	201.9423	201.7366	202.1544	202.1544	203.0660	(39)

Average = Sum(39)m / 12 = 202.6292 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5001	1.4963	1.4945	1.4909	1.4909	1.4829	1.4860	1.4844	1.4829	1.4860	1.4860	1.4927	(40)
HLP (average)												1.4895	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
RHI water heating demand												2275 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834	(83)
Total gains	1559.9480	2013.5033	2540.4080	3130.1000	3360.6719	3509.0568	3377.9562	3170.4507	2824.8287	2197.8395	1697.3069	1435.9377	(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	46.2920	46.4101	46.4671	46.5774	46.5774	46.8295	46.7327	46.7818	46.8295	46.7327	46.7327	46.5229	
alpha	4.0861	4.0940	4.0978	4.1052	4.1052	4.1220	4.1155	4.1188	4.1220	4.1155	4.1155	4.1015	
util living area													
	0.9691	0.9255	0.8134	0.6191	0.4264	0.2409	0.1316	0.1528	0.3538	0.7008	0.9232	0.9763	(86)
MIT	19.9680	20.2669	20.6518	20.9016	20.9822	20.9988	20.9999	20.9999	20.9939	20.8711	20.4018	19.9053	(87)
Th 2	19.6874	19.6903	19.6916	19.6943	19.6943	19.7003	19.6980	19.6992	19.7003	19.6980	19.6980	19.6930	(88)
util rest of house													
	0.9588	0.9038	0.7688	0.5545	0.3524	0.1667	0.0537	0.0700	0.2635	0.6221	0.8960	0.9682	(89)
MIT 2	18.4152	18.8286	19.3270	19.6100	19.6837	19.7000	19.6980	19.6992	19.6982	19.5950	19.0286	18.3312	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8802	19.2594	19.7237	19.9968	20.0726	20.0890	20.0879	20.0887	20.0862	19.9772	19.4398	18.8026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7302	19.1094	19.5737	19.8468	19.9226	19.9390	19.9379	19.9387	19.9362	19.8272	19.2898	18.6526	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.8920	0.7643	0.5624	0.3656	0.1803	0.0681	0.0853	0.2800	0.6305	0.8853	0.9593	(94)
Useful gains	1479.9880	1796.0563	1941.7069	1760.3996	1228.6040	632.8014	230.0297	270.3326	791.0178	1385.8215	1502.6908	1377.4631	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2638.7874	2607.4718	2312.3926	1855.2264	1241.8327	633.2481	230.0331	270.3424	794.0758	1501.4322	2140.7774	2609.9229	(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													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating												3223.7124	(98)
RHI space heating demand												3224	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(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	0.3551	0.3481	0.3412	0.3063	0.2994	0.2646	0.2646	0.2576	0.2785	0.2994	0.3133	0.3272	(22b)
Effective ac	0.5630	0.5606	0.5582	0.5469	0.5448	0.5350	0.5350	0.5332	0.5388	0.5448	0.5491	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	73.5289	73.2092	72.8959	71.4240	71.1487	69.8667	69.8667	69.6293	70.3605	71.1487	71.7058	72.2882	(38)
Heat transfer coeff	206.7282	206.4085	206.0951	204.6233	204.3479	203.0660	203.0660	202.8286	203.5598	204.3479	204.9050	205.4874	(39)

Average = Sum(39)m / 12 = 204.6220 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5196	1.5173	1.5150	1.5041	1.5021	1.4927	1.4927	1.4909	1.4963	1.5021	1.5062	1.5105	(40)
HLP (average)												1.5041	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1508.7353	2064.6330	2604.9855	3115.9903	3428.9422	3389.8555	3258.3319	3002.6162	2681.9484	2125.7280	1604.2888	1376.2243	(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	45.6988	45.7695	45.8391	46.1689	46.2311	46.5229	46.5229	46.5774	46.4101	46.2311	46.1054	45.9747	
alpha	4.0466	4.0513	4.0559	4.0779	4.0821	4.1015	4.1015	4.1052	4.0940	4.0821	4.0737	4.0650	
util living area													
	0.9799	0.9395	0.8531	0.7018	0.5309	0.3787	0.2732	0.3090	0.5054	0.8031	0.9554	0.9856	(86)
MIT	19.7233	20.1048	20.5042	20.8125	20.9480	20.9897	20.9979	20.9965	20.9681	20.7288	20.1472	19.6423	(87)
Th 2	19.6728	19.6746	19.6763	19.6844	19.6859	19.6930	19.6930	19.6943	19.6903	19.6859	19.6828	19.6796	(88)
util rest of house													
	0.9736	0.9227	0.8185	0.6470	0.4636	0.3035	0.1926	0.2222	0.4169	0.7455	0.9399	0.9809	(89)
MIT 2	18.0537	18.5899	19.1232	19.5032	19.6458	19.6877	19.6924	19.6933	19.6714	19.4275	18.6665	17.9424	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.5537	19.0435	19.5368	19.8953	20.0357	20.0776	20.0834	20.0836	20.0597	19.8172	19.1099	18.4515	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4037	18.8935	19.3868	19.7453	19.8857	19.9276	19.9334	19.9336	19.9097	19.6672	18.9599	18.3015	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9652	0.9104	0.8099	0.6497	0.4741	0.3171	0.2075	0.2382	0.4322	0.7446	0.9287	0.9739	(94)
Useful gains	1456.2245	1879.5959	2109.7783	2024.4084	1625.7732	1075.0352	676.0435	715.1816	1159.1148	1582.7270	1489.9557	1340.3684	(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													
	2915.6340	2888.3850	2655.9052	2219.2015	1672.7404	1081.8603	676.8953	716.7061	1182.6221	1852.8618	2430.1563	2897.6728	(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													
	1085.8007	677.9062	406.3184	140.2511	34.9436	0.0000	0.0000	0.0000	0.0000	200.9803	676.9444	1158.6345	(98)
Space heating												4381.7792	(98)
Space heating per m2											(98) / (4) =	32.2095	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1908.8203	1502.6883	1541.4973	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9699	0.9846	0.9778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1851.3309	1479.5710	1507.2090	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3813.0557	3665.6487	3372.0298	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1412.4419	1626.4417	1387.4266	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4426.3103 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	355.7061	409.5993	349.4063	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1114.7118 (107)
Space cooling per m2 8.1940 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4767.9861 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1085.8007	677.9062	406.3184	140.2511	34.9436	0.0000	0.0000	0.0000	0.0000	200.9803	676.9444	1158.6345	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	1181.5024	737.6564	442.1311	152.6127	38.0235	0.0000	0.0000	0.0000	0.0000	218.6946	736.6098	1260.7557	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m	90.0020	89.4124	88.2210	85.8569	83.2716	81.8000	81.8000	81.8000	81.8000	86.6609	89.3488	90.1354	(217)

Fuel for water heating, kWh/month

248.4935	220.5325	234.8911	216.5839	219.0003	199.4476	191.7786	210.1229	209.6522	222.4908	227.9159	242.2273	(219)

Water heating fuel used 2643.1368 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	88.9265	102.3998	87.3516	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 278.6779 (221)
Annual totals kWh/year
Space heating fuel - main system 4767.9861 (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) 479.9848 (232)
Total delivered energy for all uses 8244.7856 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4767.9861	3.4800	165.9259	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2643.1368	3.4800	91.9812	(247)
Space cooling	278.6779	13.1900	36.7576	(248)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	479.9848	13.1900	63.3100	(250)
Additional standing charges			120.0000	(251)
Total energy cost			487.8672	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.1318 (257)
SAP value 84.2111
SAP rating (Section 12) 84 (258)
SAP band B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4767.9861	0.2160	1029.8850	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2643.1368	0.2160	570.9175	(264)
Space and water heating			1600.8025	(265)
Space cooling	278.6779	0.5190	144.6339	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Total kg/year			2033.4735	(272)
CO2 emissions per m2			14.9500	(273)
EI value			84.9489	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.00) / 0.9190 = 3.787, stars = 5
Main heating environmental impact 0.216 × (1 + 0.29 × 0.00) / 0.9190 = 0.2350, stars = 4
Water heating energy efficiency 3.48 / 0.8584 = 4.054, stars = 4
Water heating environmental impact 0.216 / 0.8584 = 0.2516, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.2924	0.2785	0.2715	0.2576	0.2576	0.2228	0.2367	0.2298	0.2228	0.2367	0.2367	0.2646	(22b)
Effective ac	0.5428	0.5388	0.5369	0.5332	0.5332	0.5248	0.5280	0.5264	0.5248	0.5280	0.5280	0.5350	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	70.8796	70.3605	70.1105	69.6293	69.6293	68.5373	68.9551	68.7431	68.5373	68.9551	68.9551	69.8667	(38)
Heat transfer coeff	204.0789	203.5598	203.3097	202.8286	202.8286	201.7366	202.1544	201.9423	201.7366	202.1544	202.1544	203.0660	(39)

Average = Sum(39)m / 12 = 202.6292 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5001	1.4963	1.4945	1.4909	1.4909	1.4829	1.4860	1.4844	1.4829	1.4860	1.4860	1.4927	(40)
HLP (average)												1.4895	(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	2.9091	(42)
Average daily hot water use (litres/day)	103.2920	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:		
Store volume	230.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.8050	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.0287	(55)
Total storage loss		

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834	(83)
Total gains	1559.9480	2013.5033	2540.4080	3130.1000	3360.6719	3509.0568	3377.9562	3170.4507	2824.8287	2197.8395	1697.3069	1435.9377	(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	46.2920	46.4101	46.4671	46.5774	46.5774	46.8295	46.7327	46.7818	46.8295	46.7327	46.7327	46.5229	
alpha	4.0861	4.0940	4.0978	4.1052	4.1052	4.1220	4.1155	4.1188	4.1220	4.1155	4.1155	4.1015	
util living area													
	0.9691	0.9255	0.8134	0.6191	0.4264	0.2409	0.1316	0.1528	0.3538	0.7008	0.9232	0.9763	(86)
MIT	19.9680	20.2669	20.6518	20.9016	20.9822	20.9988	20.9999	20.9999	20.9939	20.8711	20.4018	19.9053	(87)
Th 2	19.6874	19.6903	19.6916	19.6943	19.6943	19.7003	19.6980	19.6992	19.7003	19.6980	19.6980	19.6930	(88)
util rest of house													
	0.9588	0.9038	0.7688	0.5545	0.3524	0.1667	0.0537	0.0700	0.2635	0.6221	0.8960	0.9682	(89)
MIT 2	18.4152	18.8286	19.3270	19.6100	19.6837	19.7000	19.6980	19.6992	19.6982	19.5950	19.0286	18.3312	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8802	19.2594	19.7237	19.9968	20.0726	20.0890	20.0879	20.0887	20.0862	19.9772	19.4398	18.8026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7302	19.1094	19.5737	19.8468	19.9226	19.9390	19.9379	19.9387	19.9362	19.8272	19.2898	18.6526	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.8920	0.7643	0.5624	0.3656	0.1803	0.0681	0.0853	0.2800	0.6305	0.8853	0.9593	(94)
Useful gains	1479.9880	1796.0563	1941.7069	1760.3996	1228.6040	632.8014	230.0297	270.3326	791.0178	1385.8215	1502.6908	1377.4631	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2638.7874	2607.4718	2312.3926	1855.2264	1241.8327	633.2481	230.0331	270.3424	794.0758	1501.4322	2140.7774	2609.9229	(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													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating												3223.7124	(98)
Space heating per m2											(98) / (4) =	23.6968	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1452.5034	1051.2028	1090.4885	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9897	0.9964	0.9947	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1437.5484	1047.3696	1084.7180	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3949.7992	3802.8865	3564.9716	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1808.8206	2050.1046	1845.3087	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 5704.2338 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	455.5292	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 455.5292 (107)
Space cooling per m2 3.3485 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3507.8481 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	938.1358	593.3310	300.0981	74.2931	10.7097	0.0000	0.0000	0.0000	0.0000	93.5956	499.9155	997.7694	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m 89.6207	88.9821	87.2768	84.2878	82.2629	81.8000	81.8000	81.8000	81.8000	84.6706	88.5424	89.7684 (217)

Fuel for water heating, kWh/month

249.5506	221.5989	237.4323	220.6160	221.6856	199.4476	191.7786	210.1229	209.6522	227.7207	229.9916	243.2175 (219)

Water heating fuel used 2662.8145 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	113.8823	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)

Cooling 113.8823 (221)
Annual totals kWh/year
Space heating fuel - main system 3507.8481 (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) 479.9848 (232)
Total delivered energy for all uses 6839.5298 (238)

10a. Fuel costs - using BEDF prices (374)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3507.8481	4.1800	146.6281	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2662.8145	4.1800	111.3056	(247)
Space cooling	113.8823	14.8100	16.8660	(248)
Pumps and fans for heating	75.0000	14.8100	11.1075	(249)
Energy for lighting	479.9848	14.8100	71.0858	(250)
Additional standing charges			109.0000	(251)
Total energy cost			465.9929	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3507.8481	0.2160	757.6952	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2662.8145	0.2160	575.1679	(264)
Space and water heating			1332.8631	(265)
Space cooling	113.8823	0.5190	59.1049	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Total kg/year			1680.0052	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3507.8481	1.2200	4279.5747	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2662.8145	1.2200	3248.6337	(264)
Space and water heating			7528.2084	(265)
Space cooling	113.8823	3.0700	349.6187	(266)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	479.9848	3.0700	1473.5534	(268)
Primary energy kWh/year			9581.6305	(272)
Primary energy kWh/m2/year			70.4324	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

(For testing purposes):

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

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 84
Potential environmental impact rating: B 85

Fuel prices for cost data on this page from database revision number 374 TEST (25 Feb 2015)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£99	£99	£0
Mains gas	£367	£367	£0
Space heating	£267	£267	£0
Space cooling	£17	£17	£0
Water heating	£111	£111	£0
Lighting	£71	£71	£0
Total cost of fuels	£466	£466	£0
Total cost of uses	£466	£466	£0
Delivered energy	50 kWh/m²	50 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.7 tonnes	1.7 tonnes	0.0 tonnes
CO2 emissions per m²	12 kg/m²	12 kg/m²	0 kg/m²
Primary energy	70 kWh/m²	70 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1044.74 (P1)
Transmission heat loss coefficient	133.20 (37)
Summer heat loss coefficient	1177.94 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
East	1.000	1.00	1.000	1.000 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
South	31.9300	112.2060	0.6300	0.7000	0.9000	1279.7897
West	13.6400	117.5071	0.6300	0.7000	0.9000	572.5349
East	5.4400	117.5071	0.6300	0.7000	0.9000	228.3424
West	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
East	3.5500	203.0000	0.5700	0.7000	1.0000	258.7854
total:						3253.6613

	Jun	Jul	Aug	
Solar gains	3424	3254	2992	(P3)
Internal gains	607	584	594	
Total summer gains	4031	3838	3586	(P5)
Summer gain/loss ratio	3.42	3.26	3.04	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.67	21.41	21.09	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 23000 3 Bed Penthouse Duplex
Survey Reference: Penthouse - Be Green
Property: London, EC1N 8JR

Issued on Date: 25.Mar.2015
Prop Type Ref:

SAP Rating:	91 B	**CO2 Emissions (t/year):**	0.80	**DER:**	9.50 Pass	**TER:**	16.15	**Percentage DER<TER:**	41.17 %
Environmental:	91 B	**General Requirements Compliance:**	Pass	**DFEE:**	48.52 Pass	**TFEE:**	55.75	**Percentage DFEE<TFEE:**	12.96 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: admin Admin, Tel: 4, Fax: s@l.f Surveyor ID: Admin
Address:
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 2.02r19
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Penthouse - Be Green'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Flat)     25/03/2015

FullRefNo:                    Penthouse - Be Green

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     EC1N 8JR
DwellingOrientation:          North
Property Type:                Flat, End-Terrace
Storeys:                      2
Date Built:                   2015
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              39.29, 69.8, 2.87
    2nd Storey:              30.57, 66.24, 2.95
Living Area:                  40.74 m2, fraction: 29.9%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Medium
Thermal MassValue:            250
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               77.23, 150.02, 150, Other, Cavity, 0, 0.11, Gross
Shelter Wall                  50.19, 51.95, 18, Other, Cavity, 0.43, 0.105031987014227, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  44.61, 110, PartyWallSinglePlasterLightweight, Solid, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Penthouse GF Roof        16.89, 16.89, 0, Other, 0.11
    Penthouse FF Roof        66.63, 70.18, 0, Other, 0.11
Heat Loss Floors              Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            69.8, 30
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                Manufacturer, Door to Corridor, , , , , , ,
    French Doors             Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Skylight                 Manufacturer, Roof Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Flat Door                Door to Corridor, Shelter Wall, North, , , , , 0, 0, 0, 1.76,
    Front French Doors       Window, External Wall 1, East, , None, 0, , 0, 0, 0, 5.44,
    Front Windows            Window, External Wall 1, East, , None, 0, , 0, 0, 0, 10.89,
    Side Windows             Window, External Wall 1, South, , None, 0, , 0, 0, 0, 31.93,
    Rear Windows             Window, External Wall 1, West, , None, 0, , 0, 0, 0, 13.64,
    Rear French Door         Window, External Wall 1, West, , None, 0, , 0, 0, 0, 10.89,
    Skylight Door            Roof Window, Penthouse FF Roof, East, 0, None, , , 0, 0, 0, 3.55,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.071
    List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                       External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 28.88, 0.3, 0.3, 8.66,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 28.08, 0.04, 0.04, 1.12,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 69.88, 0.05, 0.05, 3.49,
    3.                       External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 30.57, 0.07, 0.07, 2.14,
    4.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 39.29, 0.07, 0.07, 2.75,
    5.                       External wall, E16 Corner (normal), Table K1 - Approved, Yes, 11.64, 0.09, 0.09, 1.05,
    6.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 11.64, 0.06, 0.06, 0.70,
    7.                       External roof, R1 Head of roof window, Table K1 - Default, Yes, 2.45, 0.08, 0.08, 0.20,
    8.                       External roof, R2 Sill of roof window, Table K1 - Default, Yes, 2.45, 0.06, 0.06, 0.15,
    9.                       External roof, R3 Jamb of roof window, Table K1 - Default, Yes, 2.9, 0.08, 0.08, 0.23,
Pressure Test:                True
Designed q50:                 4
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System
    Cooled Area              137.04
```

```
    Data Source              SAP table
    Type                     Split or Multi-Split
    Class                    A
    Control                  On/Off
Light Fittings:               16
LEL Fittings:                 16
Percentage of LEL Fittings:   100
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
    MHS                      Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                 102
    Boiler Efficiency Type   Sedbuk 2009
    Efficiency               91
    Model Name               tbc
    Manufacturer             tbc
    Controls by PCDF         0
    MHS Controls             CBI Time and temperature zone control
    Boiler Interlock         Yes
    Compensator              0
    Delayed Start Stat       Yes
    Ctrl SAP Code            2110
    Burner Control           OnOff
    Flue Type                Balanced
    Fan Assisted Flue        Yes
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Radiators
    Flow Temperature         Normal (> 45°C)
Main Heating 2                None
Heating Systems Interaction   Each system heats separate parts of dwelling
Smoke Control Area            Unknown
Community Heating             None
Secondary Heating             None
Water Heating
    Type                     MainHeating1
    WHS                      HWP From main heating 1
    Low Water Usage          Yes
    SAP Code                 901
    Showers in Property      Non-electric only
    Hot Water Cylinder
    Cylinder Type            HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume          230.00
    Cylinder Stat            Yes
    Pipeworks Insulated      Fully insulated primary pipework
    Cylinder in Heated Space Yes
    Separate Time Control    Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit
Type                          More Dwellings, One Block
Apportioned Energy            1697
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None
```

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

---

DWELLING AS DESIGNED

Top-floor flat, total floor area 136 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.15 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.50 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)48.5 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.11 (max. 0.30)	0.11 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.70 (max. 3.30)	OK

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

---

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

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 91.0% SEDBUK2009
Minimum: 88.0%   OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage   Nominal cylinder loss: 1.91 kWh/day
Permitted by DBSCG 2.43   OK

Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum	75%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	16.33 m^2, No overhang	
Windows facing South:	31.93 m^2, No overhang	
Windows facing West:	24.53 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

10 Key features

External wall U-value	0.11 W/m^2K
External wall U-value	0.11 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Roof U-value	0.11 W/m^2K
Roof window U-value	1.00 W/m^2K

Photovoltaic array

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(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	0.3551	0.3481	0.3412	0.3063	0.2994	0.2646	0.2646	0.2576	0.2785	0.2994	0.3133	0.3272	(22b)
Effective ac	0.5630	0.5606	0.5582	0.5469	0.5448	0.5350	0.5350	0.5332	0.5388	0.5448	0.5491	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	73.5289	73.2092	72.8959	71.4240	71.1487	69.8667	69.8667	69.6293	70.3605	71.1487	71.7058	72.2882	(38)
Heat transfer coeff	206.7282	206.4085	206.0951	204.6233	204.3479	203.0660	203.0660	202.8286	203.5598	204.3479	204.9050	205.4874	(39)

Average = Sum(39)m / 12 = 204.6220 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5196	1.5173	1.5150	1.5041	1.5021	1.4927	1.4927	1.4909	1.4963	1.5021	1.5062	1.5105	(40)
HLP (average)												1.5041	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	536.2845	534.0232	516.5884	488.1117	458.5625	430.5393	412.6094	419.1908	434.0535	462.7661	495.8146	521.2125	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1270.9013	1829.7991	2380.8402	2907.3579	3236.4905	3209.9168	3083.8853	2825.1695	2493.8133	1922.0799	1384.4599	1143.8826	(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	45.6988	45.7695	45.8391	46.1689	46.2311	46.5229	46.5229	46.5774	46.4101	46.2311	46.1054	45.9747	
alpha	4.0466	4.0513	4.0559	4.0779	4.0821	4.1015	4.1015	4.1052	4.0940	4.0821	4.0737	4.0650	
util living area													
	0.9889	0.9579	0.8816	0.7339	0.5576	0.3989	0.2884	0.3279	0.5384	0.8414	0.9721	0.9925	(86)
MIT	19.5798	19.9838	20.4243	20.7781	20.9379	20.9876	20.9974	20.9957	20.9599	20.6704	20.0260	19.4991	(87)
Th 2	19.6728	19.6746	19.6763	19.6844	19.6859	19.6930	19.6930	19.6943	19.6903	19.6859	19.6828	19.6796	(88)
util rest of house													
	0.9851	0.9454	0.8512	0.6802	0.4885	0.3201	0.2034	0.2360	0.4461	0.7891	0.9616	0.9899	(89)
MIT 2	17.8483	18.4238	19.0230	19.4666	19.6374	19.6866	19.6923	19.6930	19.6661	19.3629	18.4988	17.7360	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.3668	18.8910	19.4426	19.8594	20.0269	20.0762	20.0831	20.0831	20.0536	19.7544	18.9561	18.2639	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2168	18.7410	19.2926	19.7094	19.8769	19.9262	19.9331	19.9331	19.9036	19.6044	18.8061	18.1139	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9792	0.9339	0.8409	0.6813	0.4989	0.3344	0.2191	0.2530	0.4618	0.7853	0.9520	0.9854	(94)
Useful gains	1244.4654	1708.8573	2001.9787	1980.6554	1614.5842	1073.2542	675.7960	714.6970	1151.5196	1509.4660	1317.9830	1127.1555	(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													
	2876.9977	2856.8916	2636.5001	2211.8451	1670.9331	1081.5635	676.8474	716.6154	1181.3704	1840.0359	2398.6482	2859.1413	(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													
	1214.6040	771.4791	472.0839	166.4566	41.9236	0.0000	0.0000	0.0000	0.0000	245.9440	778.0790	1288.5975	(98)
Space heating												4979.1676	(98)
Space heating per m2											(98) / (4) =	36.6008	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1908.8203	1502.6883	1541.4973	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9699	0.9846	0.9778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1851.3309	1479.5710	1507.2090	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3813.0557	3665.6487	3372.0298	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1412.4419	1626.4417	1387.4266	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4426.3103 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	355.7061	409.5993	349.4063	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1114.7118 (107)
Space cooling per m2 8.1940 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5418.0278 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1214.6040	771.4791	472.0839	166.4566	41.9236	0.0000	0.0000	0.0000	0.0000	245.9440	778.0790	1288.5975	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	1321.6583	839.4767	513.6930	181.1279	45.6187	0.0000	0.0000	0.0000	0.0000	267.6213	846.6583	1402.1735	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m 90.1688	89.6468	88.5642	86.2788	83.5156	81.8000	81.8000	81.8000	81.8000	87.1701	89.6050	90.2849 (217)

Fuel for water heating, kWh/month

248.0339	219.9558	233.9808	215.5248	218.3604	199.4476	191.7786	210.1229	209.6522	221.1910	227.2641	241.8262 (219)

Water heating fuel used 2637.1384 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	88.9265	102.3998	87.3516	0.0000	0.0000	0.0000	0.0000 (221)

Cooling 278.6779 (221)
Annual totals kWh/year
Space heating fuel - main system 5418.0278 (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) 479.9848 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
Total delivered energy for all uses 8888.8290 (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	5418.0278	0.2160	1170.2940	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2637.1384	0.2160	569.6219	(264)
Space and water heating			1739.9159	(265)
Space cooling	278.6779	0.5190	144.6339	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Energy saving/generation technologies				
PV Unit	-1697.0000	0.5190	-880.7430	(269)
Total CO2, kg/year			1291.8439	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.5000	(273)

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

DER		9.5000	ZC1
Total Floor Area	TFA	136.0400	
Assumed number of occupants	N	2.9091	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.2796	ZC2
CO2 emissions from cooking, equation (L16)		1.3880	ZC3
Total CO2 emissions		24.1675	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		24.1675	ZC8

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	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3511	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3247	(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	0.4141	0.4059	0.3978	0.3572	0.3491	0.3085	0.3085	0.3004	0.3247	0.3491	0.3653	0.3816	(22b)
Effective ac	0.5857	0.5824	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5728	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8811			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4133	(36)
Total fabric heat loss					(33) + (36) =		97.2944	(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	76.4904	76.0558	75.6297	73.6284	73.2539	71.5109	71.5109	71.1881	72.1823	73.2539	74.0114	74.8033	(38)
Heat transfer coeff	173.7849	173.3502	172.9241	170.9228	170.5484	168.8053	168.8053	168.4825	169.4767	170.5484	171.3058	172.0977	(39)
Average = Sum(39)m / 12 =												170.9210	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2775	1.2743	1.2711	1.2564	1.2537	1.2409	1.2409	1.2385	1.2458	1.2537	1.2592	1.2651	(40)
HLP (average)												1.2564	(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		2.9091 (42)
Average daily hot water use (litres/day)		103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)
Water storage loss:													
Store volume												230.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7973	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9706	(55)
Total storage loss	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(56)
If cylinder contains dedicated solar storage	30.0872	27.1756	30.0872	29.1167	30.0872	29.1167	30.0872	30.0872	29.1167	30.0872	29.1167	30.0872	(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													

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             221.8465   195.5552   205.4207   184.2079   180.5625   161.4037   155.0724   170.0780   169.7511   191.0099   201.8957   216.5299 (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
             221.8465   195.5552   205.4207   184.2079   180.5625   161.4037   155.0724   170.0780   169.7511   191.0099   201.8957   216.5299 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   2253.3335 (64)
Heat gains from water heating, kWh/month
               98.7049    87.5494    93.2433    85.3855    84.9780    77.8031    76.5025    81.4919    80.5786    88.4518    91.2667    96.9371 (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          145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568   145.4568 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               27.1787    24.1399    19.6319    14.8626    11.1100     9.3795    10.1349    13.1737    17.6817    22.4510    26.2036    27.9341 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              304.8627   308.0262   300.0542   283.0828   261.6595   241.5246   228.0733   224.9097   232.8817   249.8531   271.2764   291.4113 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457    37.5457 (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)
             -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654  -116.3654 (71)
Water heating gains (Table 5)
              132.6679   130.2819   125.3270   118.5910   114.2177   108.0599   102.8260   109.5321   111.9148   118.8868   126.7593   130.2918 (72)
Total internal gains
              534.3463   532.0850   514.6502   486.1735   456.6242   428.6011   410.6711   417.2526   432.1153   460.8279   493.8764   519.2743 (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                                    6.9000           19.6403           0.6300             0.7000           0.7700           41.4160 (76)
South                                  13.4900           46.7521           0.6300             0.7000           0.7700          192.7456 (78)
West                                   10.3500           19.6403           0.6300             0.7000           0.7700           62.1240 (80)
East                                    1.5000           26.0000           0.6300             0.7000           1.0000           15.4791 (82)
-------------------------------------------------------------------------------------------------------------------------------------------

Solar gains    311.7648   550.3628   792.8231  1030.2524  1184.0933  1185.1493  1138.8752  1025.0351   876.4607   620.1085   377.2181   264.1986 (83)
Total gains    846.1111  1082.4478  1307.4732  1516.4259  1640.7175  1613.7503  1549.5463  1442.2876  1308.5760  1080.9364   871.0945   783.4729 (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            54.3616    54.4979    54.6322    55.2719    55.3932    55.9652    55.9652    56.0724    55.7435    55.3932    55.1483    54.8945
alpha           4.6241     4.6332     4.6421     4.6848     4.6929     4.7310     4.7310     4.7382     4.7162     4.6929     4.6766     4.6596
util living area
                0.9976     0.9924     0.9761     0.9248     0.8101     0.6326     0.4715     0.5239     0.7757     0.9593     0.9942     0.9983 (86)

MIT            19.6114    19.8411    20.1684    20.5491    20.8259    20.9596    20.9918    20.9868    20.8953    20.5008    19.9745    19.5739 (87)
Th 2           19.8585    19.8611    19.8635    19.8751    19.8773    19.8875    19.8875    19.8893    19.8835    19.8773    19.8729    19.8683 (88)
util rest of house
                0.9968     0.9898     0.9678     0.8992     0.7515     0.5376     0.3563     0.4042     0.6895     0.9402     0.9918     0.9978 (89)
MIT 2          18.0201    18.3560    18.8293    19.3669    19.7169    19.8625    19.8847    19.8844    19.8061    19.3156    18.5602    17.9720 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.2995 (91)
MIT            18.4966    18.8008    19.2303    19.7209    20.0490    20.1911    20.2162    20.2145    20.1323    19.6706    18.9837    18.4517 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT   18.4966    18.8008    19.2303    19.7209    20.0490    20.1911    20.2162    20.2145    20.1323    19.6706    18.9837    18.4517 (93)
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8. Space heating requirement

```
               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9953     0.9863     0.9618     0.8950     0.7614     0.5647     0.3910     0.4402     0.7107     0.9356     0.9891     0.9967 (94)
Useful gains   842.1580  1067.6596  1257.5511  1357.2120  1249.1772   911.3308   605.9084   634.8691   930.0076  1011.3400   861.6102   780.8536 (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
             2467.1610  2409.6986  2201.3738  1849.5459  1423.9072   943.8046   610.4401   642.6795  1022.3354  1546.9708  2035.7533  2452.6857 (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
             1209.0022   901.8502   702.2041   354.4804   129.9991     0.0000     0.0000     0.0000     0.0000   398.5093   845.3830  1243.8431 (98)
Space heating                                                                                                                       5785.2715 (98)
Space heating per m2                                                                                                 (98) / (4) =     42.5263 (99)
```

8c. Space cooling requirement

Not applicable

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

```
Fraction of space heat from secondary/supplementary system (Table 11)                                                                0.0000 (201)
Fraction of space heat from main system(s)                                                                                           1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                    93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                              0.0000 (208)
Space heating requirement                                                                                                         6187.4562 (211)

               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
             1209.0022   901.8502   702.2041   354.4804   129.9991     0.0000     0.0000     0.0000     0.0000   398.5093   845.3830  1243.8431 (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)
1293.0505 964.5457 751.0204 379.1235 139.0365 0.0000 0.0000 0.0000 0.0000 426.2132 904.1530 1330.3134 (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
221.8465 195.5552 205.4207 184.2079 180.5625 161.4037 155.0724 170.0780 169.7511 191.0099 201.8957 216.5299 (64)
Efficiency of water heater 79.8000 (216)
(217)m 88.6569 88.3881 87.8345 86.5324 83.9550 79.8000 79.8000 79.8000 79.8000 86.7319 88.2196 88.7359 (217)
Fuel for water heating, kWh/month
250.2304 221.2461 233.8725 212.8774 215.0705 202.2603 194.3263 213.1303 212.7207 220.2302 228.8558 244.0162 (219)
Water heating fuel used 2648.8369 (219)
Annual totals kWh/year
Space heating fuel - main system 6187.4562 (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) 479.9848 (232)
Total delivered energy for all uses 9391.2779 (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	6187.4562	0.2160	1336.4905 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2648.8369	0.2160	572.1488 (264)
Space and water heating			1908.6393 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	479.9848	0.5190	249.1121 (268)
Total CO2, kg/m2/year			2196.6764 (272)
Emissions per m2 for space and water heating			14.0300 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8312 (272b)
Emissions per m2 for pumps and fans			0.2861 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0300 * 1.00) + 1.8312 + 0.2861, rounded to 2 d.p.			16.1500 (273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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)	=	0.1011	(8)
Pressure test			Yes	
Measured/design q50			4.0000	
Infiltration rate			0.3011	(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)	=	0.2559	(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	0.3263	0.3199	0.3135	0.2815	0.2751	0.2431	0.2431	0.2367	0.2559	0.2751	0.2879	0.3007	(22b)
Effective ac	0.5532	0.5512	0.5491	0.5396	0.5378	0.5296	0.5296	0.5280	0.5327	0.5378	0.5414	0.5452	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		20.4924 (36)
Total fabric heat loss	(33) + (36) =	133.1992 (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	72.2480	71.9781	71.7135	70.4706	70.2381	69.1556	69.1556	68.9551	69.5726	70.2381	70.7085	71.2003	(38)
Heat transfer coeff	205.4473	205.1773	204.9127	203.6699	203.4373	202.3548	202.3548	202.1544	202.7718	203.4373	203.9077	204.3995	(39)
Average = Sum(39)m / 12 =												203.6687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5102	1.5082	1.5063	1.4971	1.4954	1.4875	1.4875	1.4860	1.4905	1.4954	1.4989	1.5025	(40)
HLP (average)												1.4971	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)
Total internal gains													
	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1181.4210	1741.1799	2294.0092	2822.9579	3153.6689	3129.3175	3005.1750	2744.0390	2411.8228	1837.5732	1297.1120	1055.2598	(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	45.9837	46.0442	46.1036	46.3850	46.4380	46.6864	46.6864	46.7327	46.5904	46.4380	46.3309	46.2194	
alpha	4.0656	4.0696	4.0736	4.0923	4.0959	4.1124	4.1124	4.1155	4.1060	4.0959	4.0887	4.0813	
util living area													
	0.9914	0.9637	0.8913	0.7456	0.5680	0.4073	0.2949	0.3363	0.5524	0.8560	0.9774	0.9944	(86)
MIT	19.5360	19.9466	20.3993	20.7665	20.9345	20.9867	20.9973	20.9953	20.9565	20.6474	19.9831	19.4531	(87)
Th 2	19.6799	19.6813	19.6828	19.6897	19.6909	19.6969	19.6969	19.6980	19.6946	19.6909	19.6883	19.6856	(88)
util rest of house													
	0.9884	0.9526	0.8625	0.6926	0.4983	0.3273	0.2083	0.2424	0.4589	0.8063	0.9687	0.9924	(89)
MIT 2	18.3894	18.7908	19.2143	19.5323	19.6558	19.6922	19.6964	19.6970	19.6766	19.4521	18.8378	18.3117	(90)
Living area fraction										fLA = Living area / (4) =		0.2995	(91)
MIT	18.7327	19.1370	19.5692	19.9019	20.0388	20.0799	20.0860	20.0858	20.0599	19.8101	19.1808	18.6535	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7327	19.1370	19.5692	19.9019	20.0388	20.0799	20.0860	20.0858	20.0599	19.8101	19.1808	18.6535	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9856	0.9470	0.8597	0.7018	0.5174	0.3511	0.2343	0.2706	0.4860	0.8115	0.9642	0.9903	(94)
Useful gains	1164.3984	1648.8332	1972.1277	1981.0721	1631.8306	1098.7859	704.0097	742.5683	1172.1023	1491.1927	1250.7398	1045.0493	(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													
	2965.1680	2921.1016	2678.0366	2240.7519	1696.4160	1108.8815	705.4029	745.1099	1208.4938	1873.6706	2463.3614	2954.2898	(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													
	1339.7726	854.9644	525.1962	186.9695	48.0516	0.0000	0.0000	0.0000	0.0000	284.5636	873.0875	1420.4749	(98)
Space heating												5533.0803	(98)
Space heating per m2											(98) / (4) =	40.6725	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1902.1356	1497.4259	1536.3734	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9684	0.9838	0.9764	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1842.0486	1473.2008	1500.1121	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3735.4565	3589.9383	3293.8992	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	1363.2537	1574.8527	1334.5776	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												4272.6840	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	340.8134	393.7132	333.6444	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												1068.1710	(107)
Space cooling per m2												7.8519	(108)
Energy for space heating												40.6725	(99)
Energy for space cooling												7.8519	(108)
Total												48.5243	(109)

Dwelling Fabric Energy Efficiency (DFEE) 48.5 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260 (1b) - (3b)	
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		395.7340	(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) =	0.1011 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.3511 (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) =	0.2984 (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	0.3805	0.3730	0.3656	0.3283	0.3208	0.2835	0.2835	0.2760	0.2984	0.3208	0.3357	0.3506	(22b)
Effective ac	0.5724	0.5696	0.5668	0.5539	0.5515	0.5402	0.5402	0.5381	0.5445	0.5515	0.5564	0.5615	(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			1.7600	1.0000	1.7600			(26)
TER Opening Type (Uw = 1.40)			30.7400	1.3258	40.7538			(27)
TER Room Window (Uw = 1.70)			1.5000	1.5918	2.3876			(27a)
External Wall 1	150.0200	30.7400	119.2800	0.1800	21.4704			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1671	8.3852			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1300	2.1957			(30)
Penthouse FF Roof	70.1800	1.5000	68.6800	0.1300	8.9284			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.8811			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4133	(36)
Total fabric heat loss					(33) + (36) =		97.2944	(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	74.7487	74.3817	74.0219	72.3320	72.0158	70.5439	70.5439	70.2714	71.1109	72.0158	72.6554	73.3241	(38)
Heat transfer coeff	172.0432	171.6761	171.3163	169.6264	169.3102	167.8384	167.8384	167.5658	168.4053	169.3102	169.9498	170.6185	(39)
Average = Sum(39)m / 12 =												169.6249	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2647	1.2620	1.2593	1.2469	1.2446	1.2337	1.2337	1.2317	1.2379	1.2446	1.2493	1.2542	(40)
HLP (average)												1.2469	(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		2.9091 (42)
Average daily hot water use (litres/day)		103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.8056	31.3158	32.3151	28.1731	27.0327	23.3272	21.6161	24.8048	25.1010	29.2528	31.9317	34.6758	(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	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	145.4568	(66)

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

	27.1787	24.1399	19.6319	14.8626	11.1100	9.3795	10.1349	13.1737	17.6817	22.4510	26.2036	27.9341	(67)

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

	304.8627	308.0262	300.0542	283.0828	261.6595	241.5246	228.0733	224.9097	232.8817	249.8531	271.2764	291.4113	(68)

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

	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	37.5457	(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)

	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)

Water heating gains (Table 5)

	48.1258	46.6009	43.4343	39.1293	36.3343	32.3989	29.0539	33.3397	34.8625	39.3183	44.3496	46.6073	(72)

Total internal gains

	446.8042	445.4040	429.7574	403.7117	375.7408	349.9400	333.8991	338.0602	352.0630	378.2594	408.4667	432.5897	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	6.9000	19.6403	0.6300	0.7000	0.7700	41.4160	(76)
South	13.4900	46.7521	0.6300	0.7000	0.7700	192.7456	(78)
West	10.3500	19.6403	0.6300	0.7000	0.7700	62.1240	(80)
East	1.5000	26.0000	0.6300	0.7000	1.0000	15.4791	(82)

Solar gains	311.7648	550.3628	792.8231	1030.2524	1184.0933	1185.1493	1138.8752	1025.0351	876.4607	620.1085	377.2181	264.1986	(83)
Total gains	758.5690	995.7668	1222.5805	1433.9642	1559.8341	1535.0893	1472.7742	1363.0953	1228.5237	998.3679	785.6848	696.7883	(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	54.9119	55.0293	55.1449	55.6943	55.7983	56.2876	56.2876	56.3792	56.0981	55.7983	55.5883	55.3704	
alpha	4.6608	4.6686	4.6763	4.7130	4.7199	4.7525	4.7525	4.7586	4.7399	4.7199	4.7059	4.6914	
util living area	0.9985	0.9945	0.9812	0.9362	0.8290	0.6556	0.4918	0.5485	0.8020	0.9691	0.9962	0.9990	(86)
MIT	19.5693	19.8000	20.1306	20.5183	20.8090	20.9539	20.9904	20.9843	20.8799	20.4616	19.9289	19.5296	(87)
Th 2	19.8686	19.8708	19.8728	19.8827	19.8845	19.8931	19.8931	19.8947	19.8898	19.8845	19.8808	19.8769	(88)
util rest of house	0.9980	0.9926	0.9745	0.9135	0.7731	0.5598	0.3731	0.4252	0.7191	0.9537	0.9947	0.9987	(89)
MIT 2	18.5693	18.8007	19.1286	19.5076	19.7624	19.8733	19.8909	19.8906	19.8276	19.4639	18.9378	18.5362	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8688	19.0999	19.4287	19.8102	20.0759	20.1969	20.2201	20.2181	20.1427	19.7627	19.2346	18.8337	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9909	0.9712	0.9118	0.7837	0.5875	0.4089	0.4625	0.7402	0.9516	0.9934	0.9982	(94)
Useful gains	756.5520	986.6987	1187.3531	1307.4891	1222.4544	901.8294	602.2556	630.3827	909.3499	950.0377	780.4790	695.5266	(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	2506.4566	2437.7894	2214.8905	1850.6658	1418.1177	939.3799	607.5992	639.7860	1017.6257	1551.3329	2062.2771	2496.7788	(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	1301.9290	975.1329	764.4878	391.0872	145.5735	0.0000	0.0000	0.0000	0.0000	447.3637	922.8946	1340.1317	(98)
Space heating												6288.6004	(98)
Space heating per m2											(98) / (4) =	46.2261	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1577.6805	1242.0038	1273.5000	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8924	0.9419	0.9214	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1407.9716	1169.8909	1173.3894	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1895.0155	1820.5013	1697.8191	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	350.6716	484.0542	390.1757	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1224.9015	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	87.6679	121.0135	97.5439	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												306.2254	(107)
Space cooling per m2												2.2510	(108)
Energy for space heating												46.2261	(99)
Energy for space cooling												2.2510	(108)
Total												48.4771	(109)
Target Fabric Energy Efficiency (TFEE)												55.7	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.2924	0.2785	0.2715	0.2576	0.2576	0.2228	0.2367	0.2298	0.2228	0.2367	0.2367	0.2646	(22b)
Effective ac	0.5428	0.5388	0.5369	0.5332	0.5332	0.5248	0.5280	0.5264	0.5248	0.5280	0.5280	0.5350	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	70.8796	70.3605	70.1105	69.6293	69.6293	68.5373	68.9551	68.7431	68.5373	68.9551	68.9551	69.8667	(38)
Heat transfer coeff	204.0789	203.5598	203.3097	202.8286	202.8286	201.7366	202.1544	201.9423	201.7366	202.1544	202.1544	203.0660	(39)

Average = Sum(39)m / 12 = 202.6292 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5001	1.4963	1.4945	1.4909	1.4909	1.4829	1.4860	1.4844	1.4829	1.4860	1.4860	1.4927	(40)
HLP (average)												1.4895	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
RHI water heating demand												2275 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834	(83)
Total gains	1559.9480	2013.5033	2540.4080	3130.1000	3360.6719	3509.0568	3377.9562	3170.4507	2824.8287	2197.8395	1697.3069	1435.9377	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
tau	46.2920	46.4101	46.4671	46.5774	46.5774	46.8295	46.7327	46.7818	46.8295	46.7327	46.7327	46.5229	
alpha	4.0861	4.0940	4.0978	4.1052	4.1052	4.1220	4.1155	4.1188	4.1220	4.1155	4.1155	4.1015	
util living area													
	0.9691	0.9255	0.8134	0.6191	0.4264	0.2409	0.1316	0.1528	0.3538	0.7008	0.9232	0.9763	(86)
MIT	19.9680	20.2669	20.6518	20.9016	20.9822	20.9988	20.9999	20.9999	20.9939	20.8711	20.4018	19.9053	(87)
Th 2	19.6874	19.6903	19.6916	19.6943	19.6943	19.7003	19.6980	19.6992	19.7003	19.6980	19.6980	19.6930	(88)
util rest of house													
	0.9588	0.9038	0.7688	0.5545	0.3524	0.1667	0.0537	0.0700	0.2635	0.6221	0.8960	0.9682	(89)
MIT 2	18.4152	18.8286	19.3270	19.6100	19.6837	19.7000	19.6980	19.6992	19.6982	19.5950	19.0286	18.3312	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8802	19.2594	19.7237	19.9968	20.0726	20.0890	20.0879	20.0887	20.0862	19.9772	19.4398	18.8026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7302	19.1094	19.5737	19.8468	19.9226	19.9390	19.9379	19.9387	19.9362	19.8272	19.2898	18.6526	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.8920	0.7643	0.5624	0.3656	0.1803	0.0681	0.0853	0.2800	0.6305	0.8853	0.9593	(94)
Useful gains	1479.9880	1796.0563	1941.7069	1760.3996	1228.6040	632.8014	230.0297	270.3326	791.0178	1385.8215	1502.6908	1377.4631	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2638.7874	2607.4718	2312.3926	1855.2264	1241.8327	633.2481	230.0331	270.3424	794.0758	1501.4322	2140.7774	2609.9229	(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													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating												3223.7124	(98)
RHI space heating demand												3224	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(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	0.3551	0.3481	0.3412	0.3063	0.2994	0.2646	0.2646	0.2576	0.2785	0.2994	0.3133	0.3272	(22b)
Effective ac	0.5630	0.5606	0.5582	0.5469	0.5448	0.5350	0.5350	0.5332	0.5388	0.5448	0.5491	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	73.5289	73.2092	72.8959	71.4240	71.1487	69.8667	69.8667	69.6293	70.3605	71.1487	71.7058	72.2882	(38)
Heat transfer coeff	206.7282	206.4085	206.0951	204.6233	204.3479	203.0660	203.0660	202.8286	203.5598	204.3479	204.9050	205.4874	(39)

Average = Sum(39)m / 12 = 204.6220 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5196	1.5173	1.5150	1.5041	1.5021	1.4927	1.4927	1.4909	1.4963	1.5021	1.5062	1.5105	(40)
HLP (average)												1.5041	(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	2.9091 (42)
Average daily hot water use (litres/day)	103.2920 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:	
Store volume	230.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103 (51)
Volume factor from Table 2a	0.8050 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.0287 (55)
Total storage loss	

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(76)
South	31.9300	46.7521	0.6300	0.7000	0.7700	456.2171	(78)
West	13.6400	19.6403	0.6300	0.7000	0.7700	81.8716	(80)
East	5.4400	19.6403	0.6300	0.7000	0.7700	32.6526	(76)
West	10.8900	19.6403	0.6300	0.7000	0.7700	65.3653	(80)
East	3.5500	26.0000	0.5700	0.7000	1.0000	33.1449	(82)

Solar gains	734.6168	1295.7759	1864.2518	2419.2462	2777.9281	2779.3775	2671.2760	2405.9787	2059.7598	1459.3138	888.6453	622.6701	(83)
Total gains	1508.7353	2064.6330	2604.9855	3115.9903	3428.9422	3389.8555	3258.3319	3002.6162	2681.9484	2125.7280	1604.2888	1376.2243	(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	45.6988	45.7695	45.8391	46.1689	46.2311	46.5229	46.5229	46.5774	46.4101	46.2311	46.1054	45.9747	
alpha	4.0466	4.0513	4.0559	4.0779	4.0821	4.1015	4.1015	4.1052	4.0940	4.0821	4.0737	4.0650	
util living area													
	0.9799	0.9395	0.8531	0.7018	0.5309	0.3787	0.2732	0.3090	0.5054	0.8031	0.9554	0.9856	(86)
MIT	19.7233	20.1048	20.5042	20.8125	20.9480	20.9897	20.9979	20.9965	20.9681	20.7288	20.1472	19.6423	(87)
Th 2	19.6728	19.6746	19.6763	19.6844	19.6859	19.6930	19.6930	19.6943	19.6903	19.6859	19.6828	19.6796	(88)
util rest of house													
	0.9736	0.9227	0.8185	0.6470	0.4636	0.3035	0.1926	0.2222	0.4169	0.7455	0.9399	0.9809	(89)
MIT 2	18.0537	18.5899	19.1232	19.5032	19.6458	19.6877	19.6924	19.6933	19.6714	19.4275	18.6665	17.9424	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.5537	19.0435	19.5368	19.8953	20.0357	20.0776	20.0834	20.0836	20.0597	19.8172	19.1099	18.4515	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4037	18.8935	19.3868	19.7453	19.8857	19.9276	19.9334	19.9336	19.9097	19.6672	18.9599	18.3015	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9652	0.9104	0.8099	0.6497	0.4741	0.3171	0.2075	0.2382	0.4322	0.7446	0.9287	0.9739	(94)
Useful gains	1456.2245	1879.5959	2109.7783	2024.4084	1625.7732	1075.0352	676.0435	715.1816	1159.1148	1582.7270	1489.9557	1340.3684	(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													
	2915.6340	2888.3850	2655.9052	2219.2015	1672.7404	1081.8603	676.8953	716.7061	1182.6221	1852.8618	2430.1563	2897.6728	(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													
	1085.8007	677.9062	406.3184	140.2511	34.9436	0.0000	0.0000	0.0000	0.0000	200.9803	676.9444	1158.6345	(98)
Space heating												4381.7792	(98)
Space heating per m2											(98) / (4) =	32.2095	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1908.8203	1502.6883	1541.4973	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9699	0.9846	0.9778	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1851.3309	1479.5710	1507.2090	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3813.0557	3665.6487	3372.0298	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1412.4419	1626.4417	1387.4266	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 4426.3103 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	355.7061	409.5993	349.4063	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1114.7118 (107)
Space cooling per m2 8.1940 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4767.9861 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1085.8007	677.9062	406.3184	140.2511	34.9436	0.0000	0.0000	0.0000	0.0000	200.9803	676.9444	1158.6345	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	1181.5024	737.6564	442.1311	152.6127	38.0235	0.0000	0.0000	0.0000	0.0000	218.6946	736.6098	1260.7557	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m	90.0020	89.4124	88.2210	85.8569	83.2716	81.8000	81.8000	81.8000	81.8000	86.6609	89.3488	90.1354	(217)

Fuel for water heating, kWh/month

248.4935	220.5325	234.8911	216.5839	219.0003	199.4476	191.7786	210.1229	209.6522	222.4908	227.9159	242.2273	(219)

Water heating fuel used 2643.1368 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	88.9265	102.3998	87.3516	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 278.6779 (221)
Annual totals kWh/year
Space heating fuel - main system 4767.9861 (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) 479.9848 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
Total delivered energy for all uses 8244.7856 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4767.9861	3.4800	165.9259	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2643.1368	3.4800	91.9812	(247)
Space cooling	278.6779	13.1900	36.7576	(248)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	479.9848	13.1900	63.3100	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1697.0000	13.1900	-223.8343	(252)
Total energy cost			264.0329	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.6125 (257)
SAP value 91.4551
SAP rating (Section 12) 91 (258)
SAP band B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4767.9861	0.2160	1029.8850	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2643.1368	0.2160	570.9175	(264)
Space and water heating			1600.8025	(265)
Space cooling	278.6779	0.5190	144.6339	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Energy saving/generation technologies				
PV Unit	-1697.0000	0.5190	-880.7430	(269)
Total kg/year			1152.7305	(272)
CO2 emissions per m2			8.4700	(273)
EI value			91.4679	
EI rating			91	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9190 = 3.787, stars = 5
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9190 = 0.2350, stars = 4
Water heating energy efficiency	3.48 / 0.8584 = 4.054, stars = 4
Water heating environmental impact	0.216 / 0.8584 = 0.2516, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	69.8000 (1b)	x	2.8700 (2b)	=	200.3260	(1b) - (3b)
First floor	66.2400 (1c)	x	2.9500 (2c)	=	195.4080	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	136.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	395.7340	(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) =	0.1011	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3011	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2785	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	3.9000	3.7000	3.7000	3.2000	3.4000	3.3000	3.2000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0500	1.0000	0.9750	0.9250	0.9250	0.8000	0.8500	0.8250	0.8000	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.2924	0.2785	0.2715	0.2576	0.2576	0.2228	0.2367	0.2298	0.2228	0.2367	0.2367	0.2646	(22b)
Effective ac	0.5428	0.5388	0.5369	0.5332	0.5332	0.5248	0.5280	0.5264	0.5248	0.5280	0.5280	0.5350	(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	
Windows (Uw = 1.20)			56.4600	1.1450	64.6489			(27)
Flat Door			1.7600	1.7000	2.9920			(26)
French Doors (Uw = 1.20)			16.3300	1.1450	18.6985			(27)
Skylight (Uw = 1.00)			3.5500	0.9615	3.4135			(27a)
External Wall 1	150.0200	72.7900	77.2300	0.1100	8.4953			(29a)
Shelter Wall	51.9500	1.7600	50.1900	0.1050	5.2716			(29a)
Penthouse GF Roof	16.8900		16.8900	0.1100	1.8579			(30)
Penthouse FF Roof	70.1800	3.5500	66.6300	0.1100	7.3293			(30)
Total net area of external elements Aum(A, m2)			289.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.7068			(33)
Party Wall 1			44.6100	0.0000	0.0000			(32)
Party Floor 1			69.8000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.4924	(36)
Total fabric heat loss (33) + (36) =	133.1992	(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	70.8796	70.3605	70.1105	69.6293	69.6293	68.5373	68.9551	68.7431	68.5373	68.9551	68.9551	69.8667	(38)
Heat transfer coeff	204.0789	203.5598	203.3097	202.8286	202.8286	201.7366	202.1544	201.9423	201.7366	202.1544	202.1544	203.0660	(39)

Average = Sum(39)m / 12 = 202.6292 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5001	1.4963	1.4945	1.4909	1.4909	1.4829	1.4860	1.4844	1.4829	1.4860	1.4860	1.4927	(40)
HLP (average)												1.4895	(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	2.9091	(42)
Average daily hot water use (litres/day)	103.2920	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6212	109.4895	105.3578	101.2261	97.0944	92.9628	92.9628	97.0944	101.2261	105.3578	109.4895	113.6212	(44)
Energy conte	168.4969	147.3685	152.0710	132.5792	127.2129	109.7751	101.7227	116.7283	118.1224	137.6603	150.2670	163.1802	(45)
Energy content (annual)										Total = Sum(45)m =		1625.1848	(45)
Distribution loss (46)m = 0.15 x (45)m	25.2745	22.1053	22.8107	19.8869	19.0819	16.4663	15.2584	17.5093	17.7184	20.6490	22.5401	24.4770	(46)

Water storage loss:		
Store volume	230.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.8050	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.0287	(55)
Total storage loss		

	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (56)
If cylinder contains dedicated solar storage												
	31.8898	28.8037	31.8898	30.8611	31.8898	30.8611	31.8898	31.8898	30.8611	31.8898	30.8611	31.8898 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (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												
	223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324 (64)
								Total per year (kWh/year) = Sum(64)m =				2274.5572 (64)
Heat gains from water heating, kWh/month												
	100.1470	88.8519	94.6854	86.7811	86.4200	79.1987	77.9446	82.9339	81.9742	89.8938	92.6622	98.3792 (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	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	174.5481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.9468	60.3498	49.0797	37.1565	27.7749	23.4488	25.3372	32.9343	44.2043	56.1275	65.5091	69.8353	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	455.0189	459.7406	447.8421	422.5117	390.5366	360.4845	340.4079	335.6862	347.5846	372.9151	404.8902	434.9422	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	55.3639	(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)													
	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	-116.3654	(71)
Water heating gains (Table 5)													
	134.6061	132.2201	127.2653	120.5292	116.1560	109.9982	104.7642	111.4703	113.8530	120.8250	128.6976	132.2301	(72)
Total internal gains													
	774.1185	768.8571	740.7338	696.7441	651.0141	610.4781	587.0559	596.6374	622.1886	666.4142	715.6435	753.5542	(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	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(76)
South	31.9300	49.1384	0.6300	0.7000	0.7700	479.5037	(78)
West	13.6400	21.5704	0.6300	0.7000	0.7700	89.9173	(80)
East	5.4400	21.5704	0.6300	0.7000	0.7700	35.8615	(76)
West	10.8900	21.5704	0.6300	0.7000	0.7700	71.7888	(80)
East	3.5500	29.0000	0.5700	0.7000	1.0000	36.9693	(82)

Solar gains	785.8295	1244.6462	1799.6742	2433.3559	2709.6578	2898.5788	2790.9003	2573.8133	2202.6401	1531.4252	981.6635	682.3834	(83)
Total gains	1559.9480	2013.5033	2540.4080	3130.1000	3360.6719	3509.0568	3377.9562	3170.4507	2824.8287	2197.8395	1697.3069	1435.9377	(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, ni1,m (see Table 9a)													
tau	46.2920	46.4101	46.4671	46.5774	46.5774	46.8295	46.7327	46.7818	46.8295	46.7327	46.7327	46.5229	
alpha	4.0861	4.0940	4.0978	4.1052	4.1052	4.1220	4.1155	4.1188	4.1220	4.1155	4.1155	4.1015	
util living area													
	0.9691	0.9255	0.8134	0.6191	0.4264	0.2409	0.1316	0.1528	0.3538	0.7008	0.9232	0.9763	(86)
MIT	19.9680	20.2669	20.6518	20.9016	20.9822	20.9988	20.9999	20.9999	20.9939	20.8711	20.4018	19.9053	(87)
Th 2	19.6874	19.6903	19.6916	19.6943	19.6943	19.7003	19.6980	19.6992	19.7003	19.6980	19.6980	19.6930	(88)
util rest of house													
	0.9588	0.9038	0.7688	0.5545	0.3524	0.1667	0.0537	0.0700	0.2635	0.6221	0.8960	0.9682	(89)
MIT 2	18.4152	18.8286	19.3270	19.6100	19.6837	19.7000	19.6980	19.6992	19.6982	19.5950	19.0286	18.3312	(90)
Living area fraction									fLA = Living area / (4) =			0.2995	(91)
MIT	18.8802	19.2594	19.7237	19.9968	20.0726	20.0890	20.0879	20.0887	20.0862	19.9772	19.4398	18.8026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7302	19.1094	19.5737	19.8468	19.9226	19.9390	19.9379	19.9387	19.9362	19.8272	19.2898	18.6526	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.8920	0.7643	0.5624	0.3656	0.1803	0.0681	0.0853	0.2800	0.6305	0.8853	0.9593	(94)
Useful gains	1479.9880	1796.0563	1941.7069	1760.3996	1228.6040	632.8014	230.0297	270.3326	791.0178	1385.8215	1502.6908	1377.4631	(95)
Ext temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	(96)
Heat loss rate W													
	2638.7874	2607.4718	2312.3926	1855.2264	1241.8327	633.2481	230.0331	270.3424	794.0758	1501.4322	2140.7774	2609.9229	(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													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating												3223.7124	(98)
Space heating per m2											(98) / (4) =	23.6968	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
Ext. temp.	5.8000	6.3000	8.2000	10.7000	13.8000	16.8000	18.8000	18.6000	16.0000	12.4000	8.7000	5.8000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1452.5034	1051.2028	1090.4885	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9897	0.9964	0.9947	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1437.5484	1047.3696	1084.7180	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3949.7992	3802.8865	3564.9716	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	1808.8206	2050.1046	1845.3087	0.0000	0.0000	0.0000	0.0000 (104)

Space cooling 5704.2338 (104)
Cooled fraction fC = cooled area / (4) = 1.0074 (105)
Intermittency factor (Table 10b)

0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	455.5292	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 455.5292 (107)
Space cooling per m2 3.3485 (108)

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 %) 91.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3507.8481 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	862.1468	545.2712	275.7901	68.2753	9.8422	0.0000	0.0000	0.0000	0.0000	86.0144	459.4224	916.9501	(98)
Space heating efficiency (main heating system 1)													
	91.9000	91.9000	91.9000	91.9000	91.9000	0.0000	0.0000	0.0000	0.0000	91.9000	91.9000	91.9000	(210)
Space heating fuel (main heating system)													
	938.1358	593.3310	300.0981	74.2931	10.7097	0.0000	0.0000	0.0000	0.0000	93.5956	499.9155	997.7694	(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

223.6491	197.1833	207.2232	185.9523	182.3651	163.1482	156.8749	171.8805	171.4955	192.8125	203.6401	218.3324	(64)

Efficiency of water heater 81.8000 (216)

(217)m	89.6207	88.9821	87.2768	84.2878	82.2629	81.8000	81.8000	81.8000	81.8000	84.6706	88.5424	89.7684	(217)

Fuel for water heating, kWh/month

249.5506	221.5989	237.4323	220.6160	221.6856	199.4476	191.7786	210.1229	209.6522	227.7207	229.9916	243.2175	(219)

Water heating fuel used 2662.8145 (219)
Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	113.8823	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 113.8823 (221)
Annual totals kWh/year
Space heating fuel - main system 3507.8481 (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) 479.9848 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
Total delivered energy for all uses 6839.5298 (238)

10a. Fuel costs - using BEDF prices (374)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3507.8481	4.1800	146.6281	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2662.8145	4.1800	111.3056	(247)
Space cooling	113.8823	14.8100	16.8660	(248)
Pumps and fans for heating	75.0000	14.8100	11.1075	(249)
Energy for lighting	479.9848	14.8100	71.0858	(250)
Additional standing charges			109.0000	(251)
Energy saving/generation technologies				
PV Unit	-1697.0000	14.8100	-251.3257	(252)
Total energy cost			214.6672	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3507.8481	0.2160	757.6952	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2662.8145	0.2160	575.1679	(264)
Space and water heating			1332.8631	(265)
Space cooling	113.8823	0.5190	59.1049	(266)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	479.9848	0.5190	249.1121	(268)
Energy saving/generation technologies				
PV Unit	-1697.0000	0.5190	-880.7430	(269)
Total kg/year			799.2622	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3507.8481	1.2200	4279.5747	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2662.8145	1.2200	3248.6337	(264)
Space and water heating			7528.2084	(265)
Space cooling	113.8823	3.0700	349.6187	(266)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	479.9848	3.0700	1473.5534	(268)
Energy saving/generation technologies				

PV Unit	-1697.0000	3.0700	-5209.7900 (269)
Primary energy kWh/year			4371.8405 (272)
Primary energy kWh/m2/year			32.1364 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: B 91

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

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

Fuel prices for cost data on this page from database revision number 374 TEST (25 Feb 2015)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£99	£99	£0
Mains gas	£367	£367	£0
Space heating	£267	£267	£0
Space cooling	£17	£17	£0
Water heating	£111	£111	£0
Lighting	£71	£71	£0
Generated (PV)	-£251	-£251	£0
Total cost of fuels	£215	£215	£0
Total cost of uses	£215	£215	£0
Delivered energy	50 kWh/m²	50 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	6 kg/m²	6 kg/m²	0 kg/m²
Primary energy	32 kWh/m²	32 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1044.74 (P1)
Transmission heat loss coefficient	133.20 (37)
Summer heat loss coefficient	1177.94 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
East	1.000	1.00	1.000	1.000 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
South	31.9300	112.2060	0.6300	0.7000	0.9000	1279.7897
West	13.6400	117.5071	0.6300	0.7000	0.9000	572.5349
East	5.4400	117.5071	0.6300	0.7000	0.9000	228.3424
West	10.8900	117.5071	0.6300	0.7000	0.9000	457.1045
East	3.5500	203.0000	0.5700	0.7000	1.0000	258.7854
total:						3253.6613

	Jun	Jul	Aug	
Solar gains	3424	3254	2992	(P3)
Internal gains	607	584	594	
Total summer gains	4031	3838	3586	(P5)
Summer gain/loss ratio	3.42	3.26	3.04	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.67	21.41	21.09	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight