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**Energy Statement and
BREEAM pre assessment report**

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Edition	Date	Amendments
01	May 2021	DRAFT
02	May 2021	BREEAM Note added
02B	September 2021	Updated report

1 EXECUTIVE SUMMARY

This energy statement has been prepared in support of the planning application for the construction of 15 apartments and 357m² of retail space at ground floor. The development includes associated cycle parking and associated ancillaries.

This document demonstrates the energy strategy approach and energy efficient measures and technologies proposed in order to meet the national and local planning requirements in relation to energy and CO₂ emissions which the scheme shall achieve in line with Reading Council Energy and Sustainability policies set up within Reading Borough Local Plan (November 2019) and the Supplemental Planning Document (SPD) (December 2019).

Target emissions are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations 2013 Part L1A.

Summary of Propose best practice energy measures

Heating system:	ASHP System with unvented hot water cylinder
Domestic Hot Water:	ASHP system and unvented hot water cylinder
Ventilation:	System 3 MEV mechanical continuous extract from wet rooms with trickle vents for bedrooms and living rooms.
Insulation:	Enhanced U-Values to all elements.
Air tightness:	APR =Flats Houses 3.0m ³ / m ² ·h @ 50pa.
Lighting:	High efficiency lamps throughout.
On site LZC technology:	Individual ASHP systems are proposed for the residential/retail units

BREEAM

This report also provides a high level BREEAM report that outlines potential targets to enable the non-residential element of this scheme to comply with BREEAM 'very good'.

Summary of results

Table 1 and Figure 1 present the regulated CO₂ emission reduction achieved for this development against the AD L2 (2013) adopting Greater London Authority (GLA) carbon emissions reporting spreadsheet (v1.1) as well as under SAP 2012 standards. The calculations at design stage demonstrate that adopting individual air source heat pump (ASHP) for providing space heating and hot water load the development exceed the 35% carbon reduction required by the Reading Borough Local Plan and Supplemental Planning Document.

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	22	1	6%
Be clean	22	0	0%
Be green	13	9	40%
Cumulative on site savings	10.7		46%

TABLE 1 - REGULATED CO₂ EMISSIONS REDUCTION OVER PART L2A 2013 WITH SAP10 EMISSION FACTORS

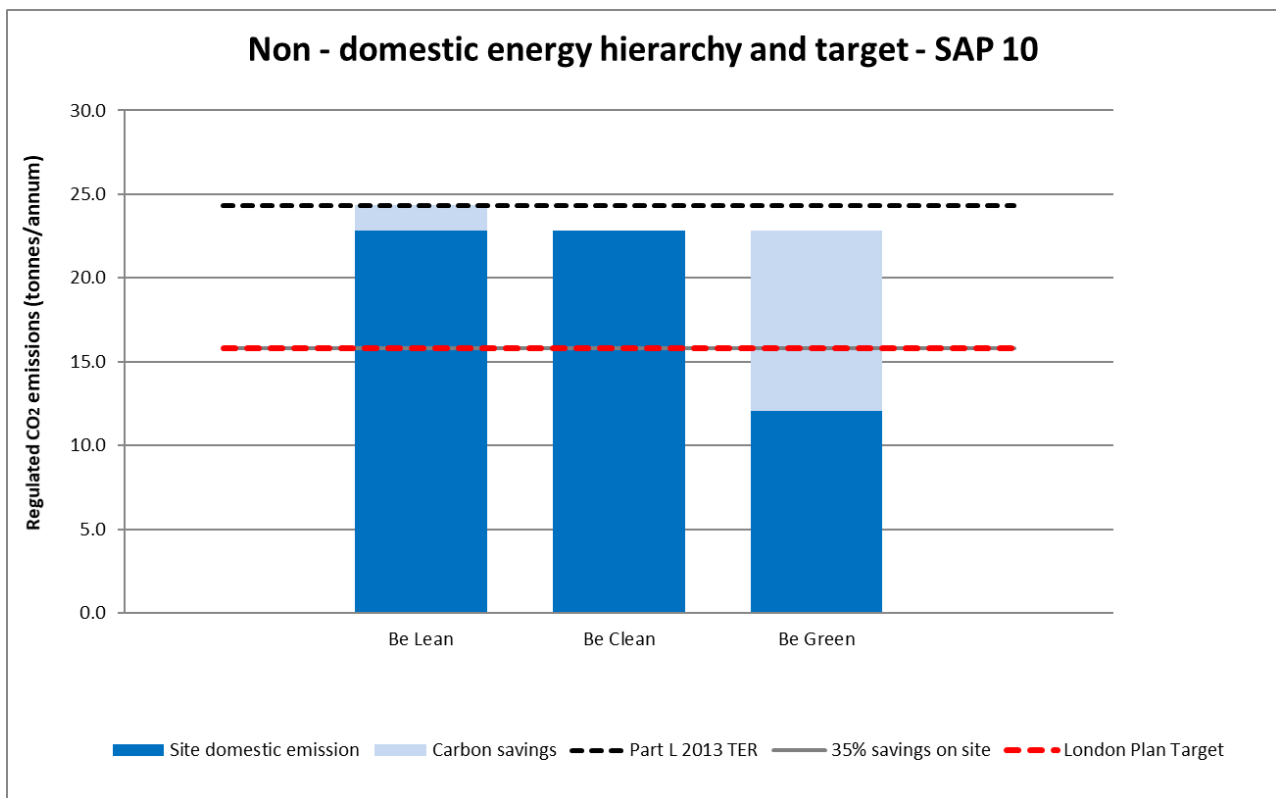


FIGURE 1 - FINAL REGULATED CO₂ EMISSION REDUCTION OVER PART L2A 2013 WITH SAP 10 EMISSION FACTO

2 METHODOLOGY

The energy statement structure follows the *Be Lean, Be Clean, Be Green* framework described by the Further Alterations to the London Plan 2016.

Current SAP 2012 carbon emissions factors have, until recently, been used for calculating predicted carbon emissions. These figures are currently 0.216 kgCO₂/kWh for gas and 0.519 kgCO₂/kWh for electricity. The draft Standard Assessment Procedure (SAP 10) published in July 2018 has lowered carbon emission factors for electricity, which reflects the rapid decarbonisation of the National Grid.

In line with Reading Borough this assessment will follow GLA Energy Assessment Guidance and the carbon emission savings will be assessed adopting the proposed SAP10 methodology in order to meet the required 35% CO₂ reduction.

	Emissions kg CO ₂ per kWh		
	SAP 2012	Draft SAP 10	2021 Predicted
Mains Gas	0.216	0.210	0.210
Electricity	0.519	0.233	0.136

TABLE 2 – CARBON EMISSIONS FACTORS

3 SUMMARY OF ENERGY STRATEGY MEASURES

The scheme has incorporated the following measures as part of the energy strategy:

Measure:	Y/N
Maximised potential of building orientation and massing	N/A
Maximised potential of natural shading for cooling	Y
Increased building fabric performance above Building Regulations	Y
Connect to an existing energy network (where available)	N
Created an energy network (where technically and economically viable)	N
Communal heating	N
Combined Heat and Power	N
Efficient individual heating systems	N
Ground Source Heat Pump	N
Air Source Heat Pump	Y
Solar Thermal	N
Photovoltaics	Y
Biomass Boiler	N

TABLE 3 – LIST OF ENERGY STRATEGY MEASURES

Table 4 and Figure 2 present the regulated CO₂ emission reduction achieved from each stage of the energy hierarchy for this development as outlined in the Draft London Plan 2017 when assessing against the AD L2 (2013) adopting GLA carbon emissions reporting spreadsheet (v1.1). The calculations at design stage demonstrate that adopting individual air source heat pump (ASHP) for the residential units and VRF system for the retail space for providing space heating and hot water load for the development exceeding the 35% carbon reduction required.

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	22	2	6%
Be clean	22	0	0%
Be green	13	9	40%
Cumulative on site savings	10.7		46%

TABLE 4 - REGULATED CO₂ EMISSIONS REDUCTION OVER PART L2A 2013 WITH SAP10 EMISSION FACTORS

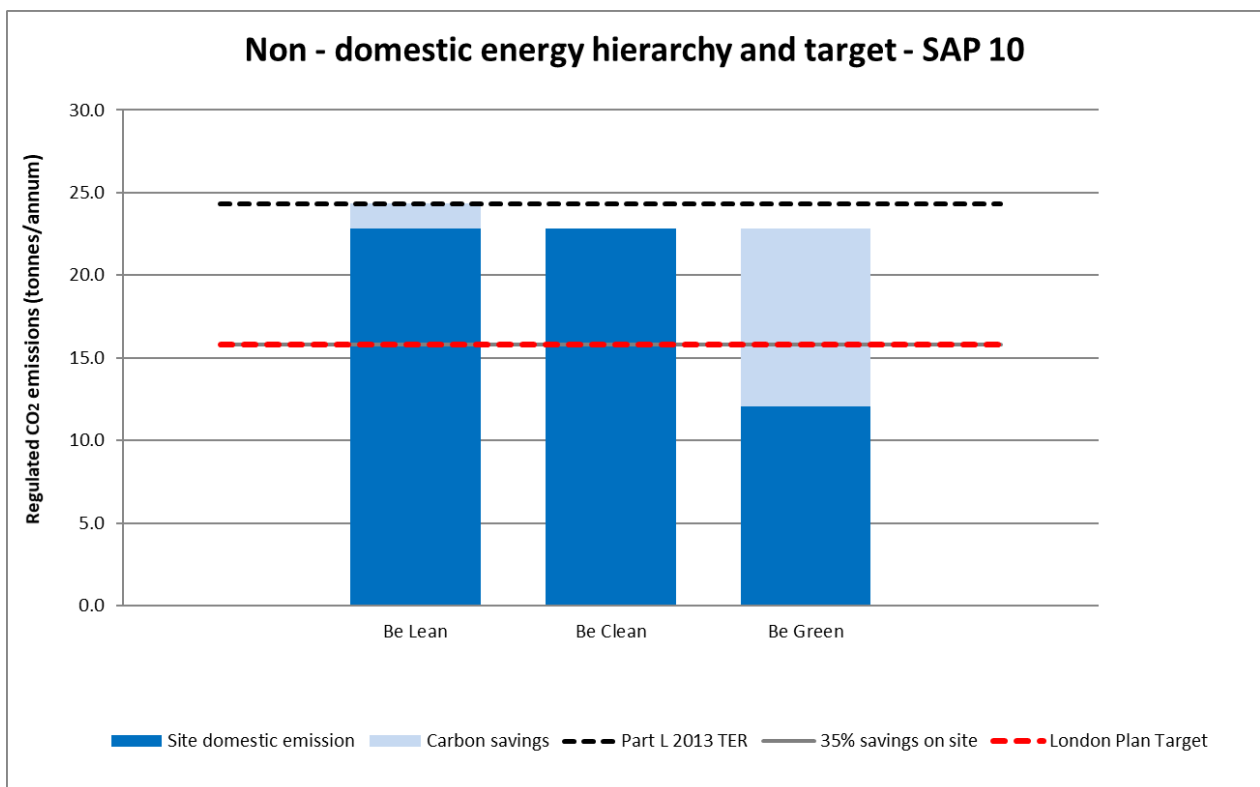


FIGURE 2 - FINAL REGULATED CO₂ EMISSION REDUCTION OVER PART L2A 2013 WITH SAP 10 EMISSION FACTO

4 APPLICABLE POLICIES

Environment and Climate Change Policy for Reading Borough

The development must follow Reading Council Energy and Sustainability policies set up within Reading Borough Local Plan (November 2019) and the Supplemental Planning Document (SPD) (December 2019).

Summary of relevant policies.

CC2: SUSTAINABLE DESIGN AND CONSTRUCTION

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;
- All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;
- All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.

CC3: ADAPTATION TO CLIMATE CHANGE

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;

- Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;
- Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and
- All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change

CC4: DECENTRALISED ENERGY

In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.

Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.

H5: STANDARDS FOR NEW HOUSING

New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:

- a. All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally-described space standard.
- b. All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations.
- c. All major new-build residential development should be designed to achieve zero carbon homes.
- d. All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.
- e. All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations, unless it is built in line with M4(3) (see below).
- f. On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'

Energy Statements demonstrate how the energy related aspects of the proposed development meets the requirements of local planning policy and BREEAM energy and emissions standards. An energy statement would typically include the following information:

- Energy efficiency of the building;
- Baseline annual predicted energy demand of the development (regulated and unregulated);
- Baseline annual predicted carbon emissions of the development (regulated and unregulated), the Target Emission Rate (TER);
- The contribution of each proposed renewable energy technology;
- Cost information of technically feasible low or zero carbon renewable technologies, including additional insulation, low carbon decentralised energy, heat pumps etc;

- Feasibility of district or community heating;
- Summary of the benefits of various energy technologies;
- The total estimated reduction in the development's baseline carbon and/or energy emissions.

Table 1: Required level of sustainability standard

	Size of Development	Required Standard
New-build residential	Minor (fewer than 10 dwellings)	19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations
	Major (10 dwellings or more)	Zero Carbon (or if unachievable, a minimum 35% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations and planning contribution to offset remaining carbon emissions to zero)
Creation of new residential units through conversion from other uses and/or major refurbishment	Minor (fewer than 10 dwellings)	BREEAM 'Very Good'
	Major (10 dwellings or more)	BREEAM 'Excellent'
Non-residential development (including development for non-C3 residential)	Minor (less than 1,000 sq. m of floorspace)	BREEAM 'Very Good'
	Major (1,000 sq. m of floorspace or more)	BREEAM 'Excellent'
Non-residential refurbishment (including refurbishment for non-C3 residential)	Minor (less than 1,000 sq. m of floorspace)	BREEAM 'Very Good'
	Major (1,000 sq. m of floorspace or more)	BREEAM 'Excellent'

Non-Residential Development

The Building Research Establishment's Environmental Assessment Method is known as BREEAM Standards and is the most widely recognised method of assessing the environmental quality of building design. The Local Plan requires BREEAM standards to be achieved for non-residential development, non-C3 forms of development such as student accommodation or residential care, and conversion to residential.

Paragraph 4.1.4 of the Local Plan recognises, however, that:

"... some types of development, such as industrial uses, warehouses and schools might find it more difficult to meet these standards. In these cases, developments must demonstrate that the standard to be achieved is the highest possible for the development, and at a minimum meets the BREEAM 'Very Good' standard."

Experience has shown that once the final details of a scheme are established, in virtually all cases credits will be dropped during the process of design and construction. This could mean that the proposal fails to comply with the policy requirements and is therefore important to incorporate a 'buffer' into the pre-assessment estimator. A 'buffer' is an over allowance of credits or contingency. This is designed in at the pre-assessment stage to ensure that if some aspects of the design cannot be achieved and credits are dropped once progression is made to later stages of the design and construction of the development, the BREEAM level set out initially is achieved. The 'buffer' is important to ensure the development as built complies with local plan policies. A 5% buffer should be included in the pre-assessment estimator.

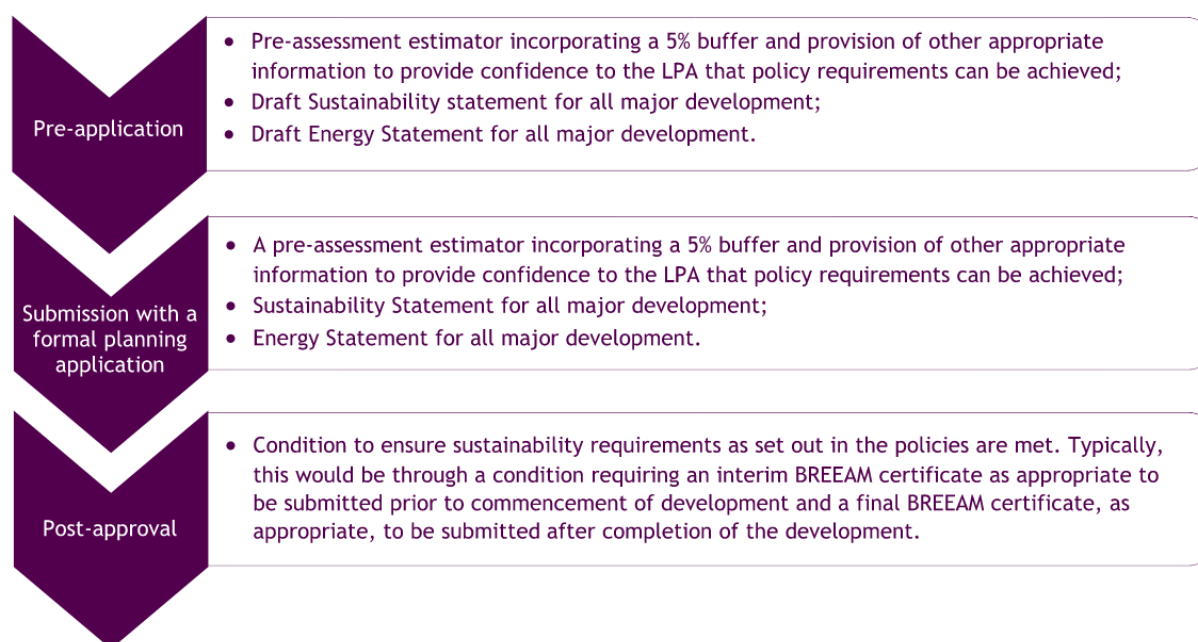


FIGURE 3 - SUMMARY OF BREEAM SUBMISSION REQUIREMENTS AT EACH STAGE OF APPLICATION

Residential Development

For residential development of ten dwellings or more, the Local Plan requires 'Zero Carbon' development, unless it can be clearly demonstrated that this would render a development unviable. Zero carbon homes is an achievable standard that, until recently, was intended to be a national requirement in the Building Regulations. It is required through planning policy for major residential new build development, and the viability of this approach was tested through the Local Plan and was not found to place an unreasonable burden on development. The paragraphs below describe the requirements in more detail.

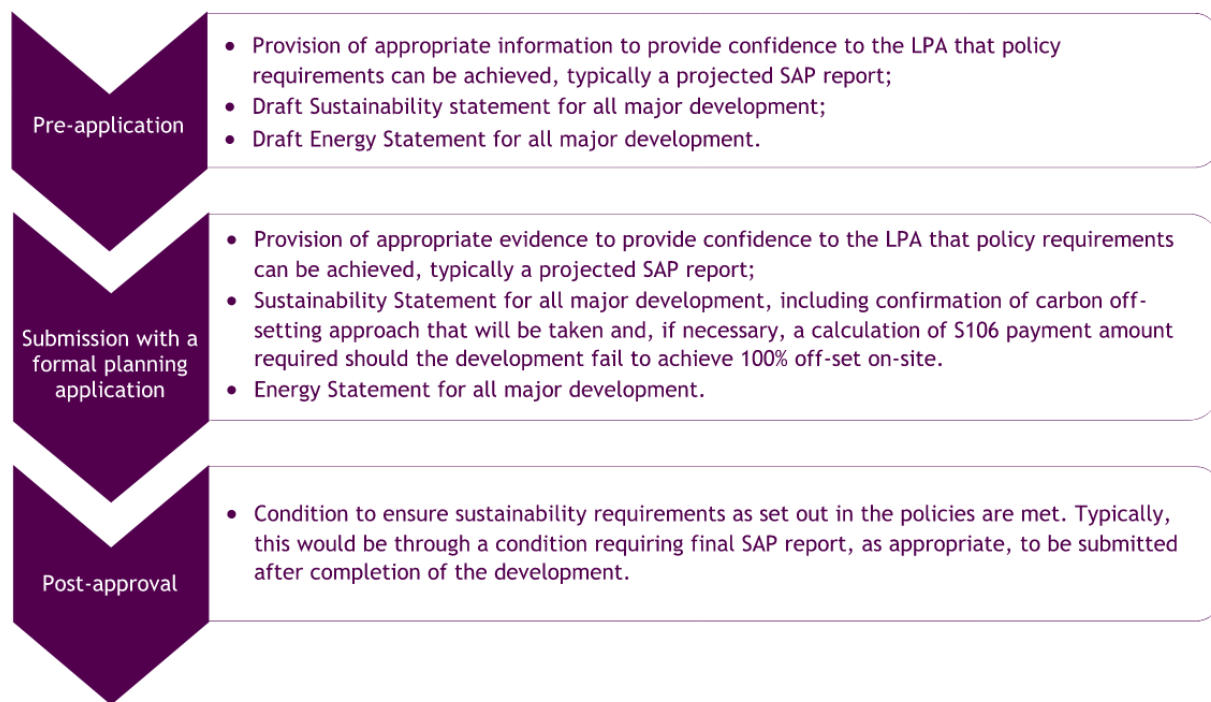


FIGURE 4 - SUMMARY OF ZERO CARBON HOMES SUBMISSION REQUIREMENTS AT EACH STAGE OF THE APPLICATION PROCESS

New build housing on sites less than 10 dwellings will achieve at a minimum a 19% improvement in regulated emissions over the target emission rate, as defined in the 2013 Building Regulations unless it can be clearly demonstrated that this would render a development unviable.

In achieving Zero Carbon Homes for major residential developments, the preference is that new build residential of ten or more dwellings will achieve true carbon neutral development on-site. If this is not achievable, it must achieve a minimum of 35% improvement in regulated emissions over the Target Emissions Rate in the 2013 Building Regulations, plus a Section 106 contribution of £1,800 per remaining tonne towards carbon offsetting within the Borough (calculated as £60/ tonne over a 30 year period). £60 per tonne of carbon is a nationally-recognised price of carbon and reflects the amount established by the Zero Carbon Hub. Based on a review of other Local Planning Authorities (LPA) carbon pricing, £60 is the amount used by a majority of LPAs and is lower than the £95/tonne proposed in the new draft London Plan¹⁷.

Where a SAP assessment is required to demonstrate compliance with policy H5 for new-build residential, applicants are expected to use SAP 2012 carbon emission factors, as well as updated (SAP 10) carbon emission factors, to assess the expected carbon performance of a new development. Applicants should undertake this approach until such time as central government adopts the new Building Regulations, at which point only SAP 10 emission factors shall be used.

Applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements as set out in Policy H5 but with the outputs manually converted for the SAP10 emission factors. This is for demonstrating performance against planning policy targets and is separate to Building Regulation compliance.

5 BASELINE EMISSIONS

In accordance with the Regional and Local Planning Policies, the energy demand and CO₂ emissions for the proposed development have been estimated in compliance with the current Building Regulations, and in particular the requirement of Part L2 2013 of the Building Regulations. The SAP10 emission factors have been applied accordingly using GLA spreadsheet.

The CO₂ emissions for the dwellings are based on initial stage SAP assessments and demonstrates the potential energy and CO₂ emission savings from the initial proposed enhancements to the scheme including the following areas:

- Enhancement to the building fabric
- Provision of a low carbon district heating network
- Provision of onsite renewable technologies

The baseline is taken as compliance with Part L2 2013 of the Building Regulations (TER).

As the development progresses through detailed design, the site CO₂ emissions can be more accurately calculated with the detailed design specification and drawings.

6 BE LEAN – USE LESS ENERGY

Passive measures

The Energy Hierarchy requires that measures are adopted in building design to reduce energy demand requirements from the use of buildings. These measures can be split into two categories as 'passive' and 'active' measures. These measures will be considered in the design of individual buildings to further reduce energy demands and use energy more efficiently.

Passive measures are design features, which can include building orientation, appropriate internal layouts and building fabric selection, that inherently reduce the buildings' energy requirements. Active measures are building services design features that will increase the efficiency of the energy used, and therefore also reduce the energy demand requirements.

The performance values, shown in Table 5, represent the best construction practice applied to this Development and represent a significant improvement over the Building Regulations Part L 2013 criteria.

Passive measures	PART L 2013	Proposed
U-values (W/m ² K)	-	-
External Walls	0.30	0.17
Party Walls	0.20	Full filled and sealed cavity (SAP U-value – 0)
Exposed Ground	0.25	0.15
Exposed Roof	0.20	0.15
Windows	2.0	1.4
Doors	2.0	1.2
Air-tightness	10 m ³ /(h m ²)	3 m ³ /(h m ²)
Thermal bridging	0.15	0.07
Water (l/person/day)	125	105
Low energy lighting	100%	100%

TABLE 5 – BUILDING FABRIC CHARACTERISTICS

The following passive measures have been proposed for this Development:

- Designing the external fabric (walls, floors, and roofs) to have low U-values to reduce thermal heat loss (i.e. by providing excellent insulation);
- Reducing air permeability and the thermal bridging coefficient of the building envelope to the lowest practical level;
- Installing openable windows (where possible), preferably on two or more aspects facing opposite sides, to allow the through-flow of air and provide effective cross ventilation

in a dwelling when required;

Active measures

The following active design measures have been proposed in the mechanical and electrical elements of the buildings:

- High efficient ASHP systems
- The use of efficient Continuous Mechanical Ventilation CMEV in the apartments and MVHR system for the retail unit;
- Adopting water efficiency measures to reduce energy demands associated with water heating (including fitting of flow restrictors on taps, low-flow showers, smaller capacity baths and time and thermostat control of hot water);
- Zonal heating controls
- Time and thermostat control of hot water;
- High efficiency lighting;

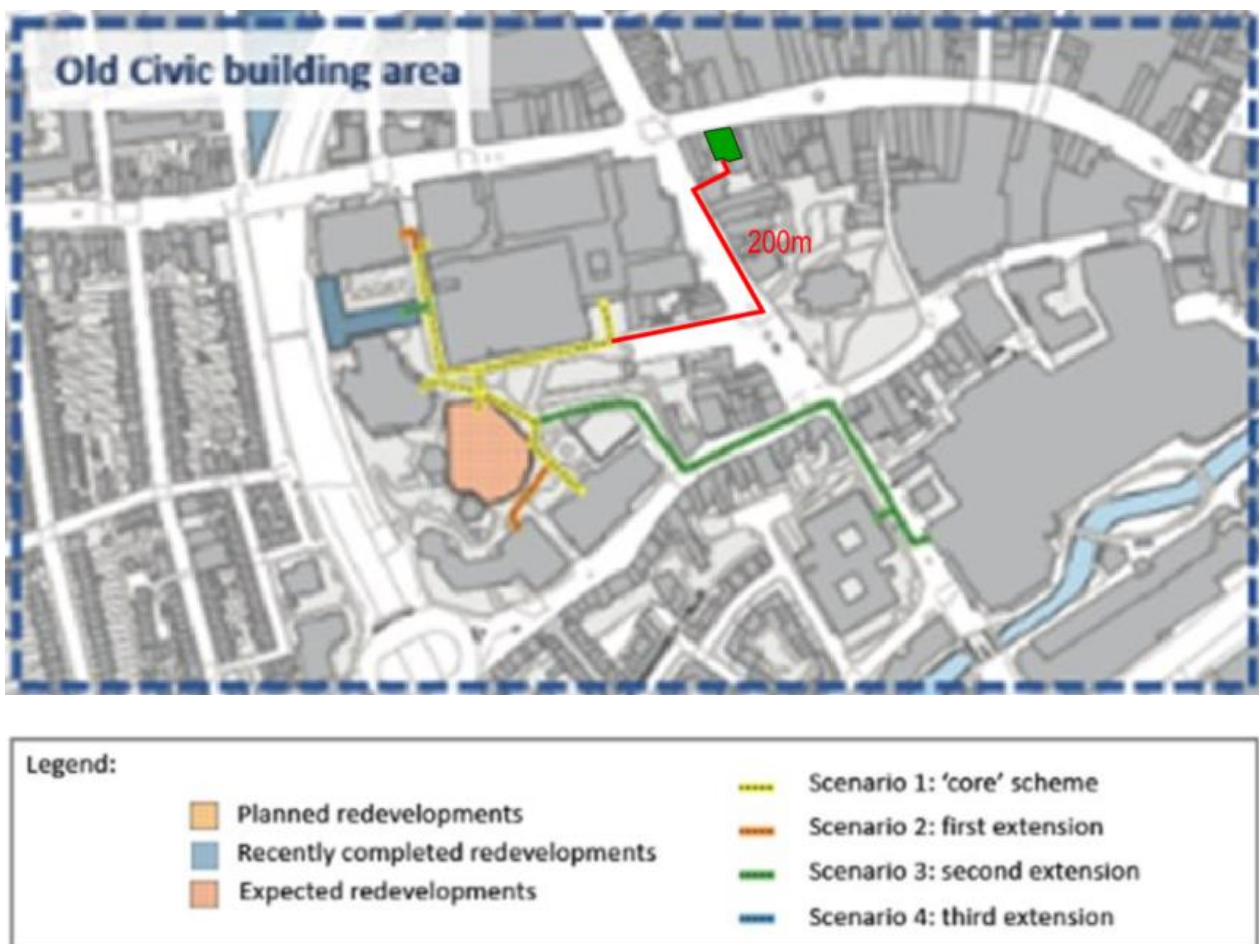
A combination of 'passive' and 'active' measures will result in well insulated, air-tight buildings with appropriate and efficient building services. In accordance with the energy hierarchy, it is important that the dwellings and commercial spaces are designed to reduce energy demands and use energy efficiently, before considering any low carbon and renewable energy technologies on-site.

7 BE CLEAN: SUPPLY ENERGY EFFICIENTLY

7.1 Connection to existing heating or cooling networks

The report has considered the feasibility of connecting into an existing or planned local district heating network.

The Sustainable Design and Construction document identified potential deliverable heat network scheme option centred on four cluster. In particular, 86-88 broad street development is located within 200m of the expected redevelopment of the Old Civic building area. However, the development has not sufficient heat load to justify a capital expenditure to install 200m of district heating pipework. The opportunity to connect to a DH network could be re-evaluated in the future when the DH network will be further extended to a closer location



7.2 Site-wide district heating network

The development comprises of fewer than 20 residential units this leads to the conclusion that this development is too small to have an energy centre serving site wide district heating network.

8 BE GREEN – USE RENEWABLE TECHNOLOGY

The following section examines the potential feasibility of incorporating on-site renewable technologies to provide further CO₂ emission reductions to achieve the targets set out in the Regional and Local Planning Policies.

The following technologies have been reviewed:

- Wind Turbines
- Photovoltaic
- Solar Thermal
- Heat Pumps
- Biomass Heating

Wind Turbines

Wind turbines can have outputs ranging from a few watts to several megawatts and produce electricity without emitting CO₂ emissions. Energy is extracted from the wind using a rotor generally consisting of two or three blades, which have a profile similar to that of an airplane wing. If the diameter of the rotor is doubled, the power output from the turbine is quadrupled at a given wind speed.

Correct assessment of the resource and sighting is critical before considering the installation of a turbine. Potential sites generally need average wind speeds of greater than 5m/s at hub height to be economically viable in the UK, although small roof mounted wind turbines (typically 1.5kW) can work at wind speeds as low as 3.5m/s. Wind energy availability varies on a seasonal basis and peaks during the winter months, which matches well with the seasonal variation in energy requirements in a development.

Although best suited to rural environments, modern wind turbines are becoming increasingly cost effective in low-density areas where there is often the opportunity to connect them immediately to the grid, or use the electricity generated directly in a dwelling. For higher density housing, they are not as cost-effective as their output will be affected by lower and disrupted average wind speeds. Rooftop mounted turbines are becoming increasingly available, where the higher average wind speeds at increased hub heights contribute to improved performance.



SUMMARY:

A stand-alone wind turbine can be excluded from consideration, as it would require sufficient open space available on the site to locate the turbine and to be far enough away from building to be able to work effectively with minimum turbulence. There appears to be no open space of sufficient size around the development to allow for this and so has been removed from consideration.

Also building mounted wind turbines may be limited due to the environmental conditions of the site, in that it may be difficult to achieve the requisite wind speeds in order to make this technology a feasible option. There may also be potential issues with regard to visual amenity and noise generation associated with certain types of wind turbine. Wind turbines have therefore been excluded from further consideration for the development.

Photovoltaic Systems

Photovoltaic or 'PV' systems convert energy from the sun into electricity through semi-conductor cells. A cell consists of a junction between two thin layers of dissimilar semi-conducting materials, based on silicon. When light shines on the junction, a difference in energy is created – otherwise known as 'voltage' or 'potential difference'. This voltage is used to produce an electrical current or direct current (DC), which can be used directly or converted into alternating current (AC). The brighter the sunlight, the more power is produced – although PV cells still produce a reduced level of power when the sun is hidden by clouds. Shading from other objects (such as nearby buildings and trees) is a key issue, as PV cells are more likely to show a drop in system output than solar thermal panels. Ideally panels should face as close to due south as possible, and not be shaded. Individual PV cells only produce a small amount of power, so are connected together to form a module. Modules can then be linked to form an array and sized to meet a particular load.

There are three main types of solar cells readily available in the UK:

Monocrystalline – very thin wafers of silicon cut from a small seed crystal. More efficient than polycrystalline, but more expensive due to the manufacturing process.

Polycrystalline – instead of one crystal, several different crystals are used for producing the slices. The result is cheaper PV cells than monocrystalline but lower efficiencies.

Amorphous silicon – silicon is made into a continuous strip of film. Cells can be produced more quickly and hence cheaply than mono or polycrystalline, but with substantially lower efficiencies.



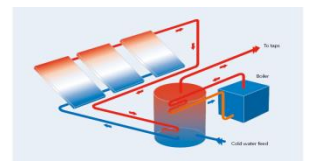
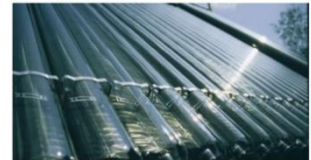
SUMMARY:

The use of PV systems for this development has been considered not feasible due to the very limited roof space and the adoption of high efficient individual ASHP systems allow to already achieve good carbon savings and meet Reading Borough climate change policies.

Solar Thermal (Solar Hot Water)

Solar thermal or solar hot water (SHW) systems for use in dwellings use a heat collector, which is generally mounted on a roof and contains a fluid (typically water with glycol) that is heated by the sun. The heated liquid is then passed through a coil in a hot water storage vessel. The heated water in the vessel may then be supplied directly, or raised to a higher temperature (if required) by a supplementary heater. In this way the 'free' energy obtained from the sun can be used to offset the amount of energy that would be required to heat the water, and will reduce both running costs (due to the fuel being displaced) and the associated CO₂ emissions. These systems do not generally provide space heating, and are among the most cost-effective renewable energy systems that can be installed on dwellings in rural or urban environments.

It must be remembered that solar thermal load must be matched to the hot water load and storage vessel sized appropriately to maximise the solar thermal energy.



SUMMARY:

The use of SHW has been considered as unfeasible for the proposed development. The CO₂ emission reduction achieved with SHW are minimal compared to other technologies. This would mean that additional renewable technologies would also be required to achieve the targets set out in the Regional and Local Planning Policies. SHW also typically generates at peak output during the summer months when the heating demand for the development will be at its lowest.

Heat Pumps - Ground Source

Ground Source Heat Pumps (GSHP) - In the UK the earth, a few meters below the surface, keeps a constant temperature of about 11-12°C throughout the year. This temperature is maintained due to the ground's high thermal mass, which stores heat from the sun during the summer. GSHPs can transfer this heat from the ground by a vapour compression cycle into a building to provide space heating and, in some cases, pre-heating for domestic hot water. For every unit of electricity used to operate the heat pump, 3-4 units of heat are produced, this is known as a heat pumps Coefficient of Performance (COP).

There are three important elements to a GSHP:

Ground loop – comprises lengths of pipe buried in the ground, either in a borehole or a horizontal trench. The pipe is a closed circuit and is filled with a mixture of water and antifreeze, which is pumped round the pipe absorbing heat from the ground. (Pictured)

Heat pump – exchanges the heat in the buried pipe work through a heat exchanger to a secondary water circuit.

Heat distribution system – under floor heating or oversized radiators for space heating and in some cases water storage for hot water supply.



SUMMARY:

After examination of the site, there does not appear to be a sufficient space available to locate individual horizontal ground loop systems to serve the entire proposed development. Alternatively, vertical borehole systems have been considered. However, it is typically recommended that there is a minimum distance of 8m between each borehole, to allow the energy in the ground to recover, preventing a drop off in performance. Due to the small available open area for placing the drilling equipment and to physically install either the horizontal and vertical ground heat exchangers this development the use of GSHP system does not appear feasible.

Heat Pumps - Air Source

Air Source Heat Pumps (ASHP) extract heat energy from a source and transfers that heat into a building by means of either; under-floor heating system (most efficient), or radiators (oversized to counter the low flow temperatures). An electric heat pump can potentially deliver 4kW of heat energy for every 1kW of electrical energy used to power the pump (COP 4:1). This technology could provide the majority of the heating for an individual dwelling or development for the year. Back up heating is provided by either a standard boiler or electric heating unit integral within the system.

ASHPs require either an area to mount an external condenser or ducting for internal exhaust air systems.

There are two main types of ASHPs:

Air-to-Water – comprises of an external heat pump unit and an internal unit containing the cylinder, expansion vessel and electric heater. The heat pump extracts heat energy from the outside atmospheric air. The heat pump removes the heat in the air and transfers that heat energy via a refrigerant, where the temperature is raised to heat domestic hot water and heating water systems. Back up heating is provided by an electric heating unit integral within the systems.

Exhaust ASHPs – Mechanical ventilation system combined with a heat pump, which extracts air via ductwork connected to the warm areas of the dwelling such as bathrooms, kitchens and utility rooms. Heat is removed from the air and transferred into the heat pump where the temperature is raised to heat the domestic hot water and radiator water. Back up heating is provided by an electric heating unit integral within the system.



SUMMARY:

Individual ASHP units will provide all of the space heating and hot water demand for the houses and apartments. Therefore, this technology has been considered feasible for the proposed development.

Biomass Boiler

Biomass is a term used to define all plant and animal material and has been used as an energy source for centuries. Although there are a number of different technologies available that extract heat from biomass, wood burning systems are most likely to be appropriate for use in community systems. Biomass or wood burning systems differ from other renewable energy sources in that CO₂ is emitted when it is burned to produce heat. However the amount of CO₂ released is only the same as the amount of carbon absorbed by the tree whilst it was growing and therefore considered essentially a carbon neutral approach.

Wood fuel can be sourced in three main forms, logs, pellets and woodchip. Logs are one of the simplest, quickest and cheapest forms of using wood fuel, although their energy density is half that of pellets, and a quarter of the energy density in woodchip.

When the technology is used on a large development for burning wood fuel it involves the use of large automatic wood chip/pellet boilers situated in a main heating centre with adjacent wood pellet fuel stores to supply the boiler. Due to the slow response rates of the boilers a thermal store can be included in the installation to smooth out the demand requirements and allows the boilers to charge the store and then set back to stand-by mode as the energy store is used.

The following must be considered at the early stages of a project to ensure a successful biomass scheme:

1. Fuel sourcing
2. Delivery of the fuel to the fuel store
3. Fuel handling
4. Boiler sizing and control
5. Local Environmental Pollution



SUMMARY:

A biomass system is not considered viable due to limited room available (required for fuel and waste ash storage and delivery of fuel), high maintenance requirements, embodied carbon of fuel deliveries and effects to local air quality. For the aforementioned reasons, a biomass boiler is not a suitable renewable technology for this development.

Be Green Results

To complete the energy hierarchy, onsite energy generation through renewable technologies has been proposed for this scheme and individual high efficient ASHP system are being proposed to deliver hot water and space heating for the development.

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	22	2	6%
Be clean	23	0	0%
Be green	13	9	40%
Cumulative on site savings	10.7		46%

Table 6 and Figure 5 below demonstrates the progress through the energy hierarchy for the residential units:

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	22	2	6%
Be clean	23	0	0%
Be green	13	9	40%
Cumulative on site savings	10.7		46%

TABLE 6 - 'BE GREEN' REGULATED CO2 EMISSIONS REDUCTION OVER PART L2A 2013 WITH SAP 10 EMISSION FACTORS

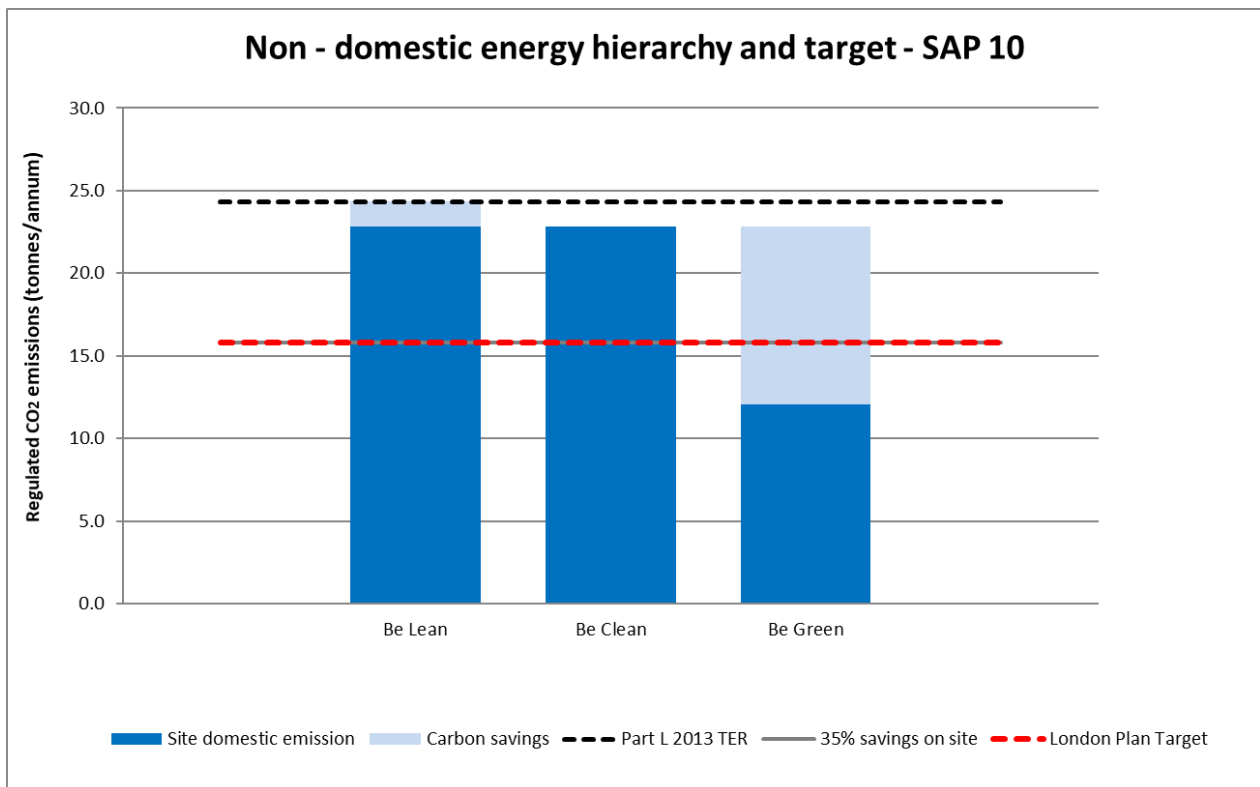


FIGURE 5 - 'BE GREEN' REGULATED CO₂ EMISSION REDUCTION OVER PART L2A 2013 WITH SAP 10 EMISSION FACTORS

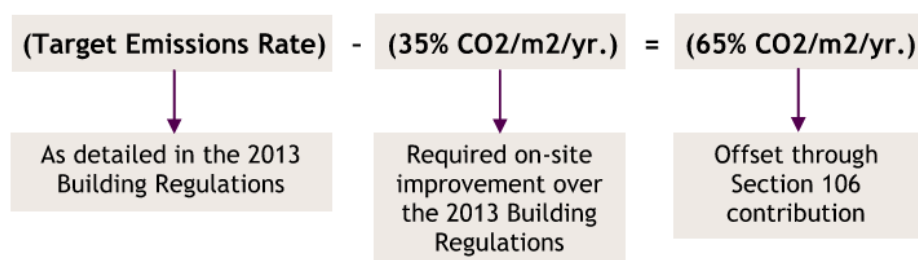
The results indicate that the proposed passive and active measures proposed the developments is achieving an estimated CO₂ emissions reduction of over 35% at Be Green stage. This is exceeding the requirements set out in the Sustainable Design and Construction document.

9 ZERO CARBON HOMES

“Zero carbon” homes applies to homes forming part of the development application (10 or more residential units) where the residential element of the application needs to achieve at least a 35 per cent reduction in regulated carbon emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emission, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to secure delivery of carbon dioxide savings elsewhere.

The “zero carbon” target is defined within the H5: Standards for New Housing states that all major new-build residential should achieve zero carbon homes over the 2013 Building regulations target.

In achieving Zero Carbon Homes for major residential developments, the preference is that new build residential of ten or more dwellings will achieve true carbon neutral development on-site. If this is not achievable, it must achieve a minimum of 35% improvement in regulated emissions over the Target Emissions Rate in the 2013 Building Regulations, plus a Section 106 contribution of £1,800 per remaining tonne towards carbon offsetting within the Borough (calculated as £60/tonne over a 30 year period). £60 per tonne of carbon is a nationally recognised price of carbon and reflects the amount established by the Zero Carbon Hub. Based on a review of other Local Planning Authorities (LPA) carbon pricing 16, £60 is the amount used by a majority of LPAs and is lower than the £95/tonne proposed in the new draft London Plan. The following calculation should be used to determine contribution



In the light of the above considerations, the Zero Carbon Homes policy does apply to the development as it is a construction of more than 10 dwellings deeming it to be a major development bearing in mind that the carbon off set payment applies only to the residential units.

	(Tonnes CO ₂)	
Cumulative savings for off-set payment	270	-
Cash in-lieu contribution (£)	£16,210	

TABLE 7 – CURRENT OFF SET PAYMENTS ACCORDING THE LONDON PLAN POLICY 5.2B

In accordance with London Plan 5.2 any shortfall in achieving the carbon dioxide reduction on-site might be provided off-site, but only in cases where there is an alternative proposal identified and delivery is certain, or where funding can be pooled to support specific carbon dioxide reduction projects or programmes. In this specific case no specific proposal has been identified and therefore it will be offset through Section 106 contribution as stated in the Sustainable Design and Construction document.

10 CONCLUSION

A series of energy efficiency and best practice measures have been adopted in order to meet the required **35% carbon reduction** set out in the Sustainable Design and Construction document.

This report has demonstrated how the development proposals make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1. Be lean: use less energy – fabric improvements, highly efficient systems and lighting
2. Be clean: supply energy efficiently – provision for connection to DH network for the school
3. Be green: use renewable energy

Overall CO₂ emissions

Table 8 and Figure 6 shows the final carbon emissions for Broad Street development site and the percentage of improvement over the baseline emissions 2013.

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2013 baseline	23		
Be lean	22	2	6%
Be clean	22	0	0%
Be green	13	10	40%
Cumulative on site savings	10.7		46%

TABLE 8 - FINAL RESIDENTIAL CO₂ REDUCTION

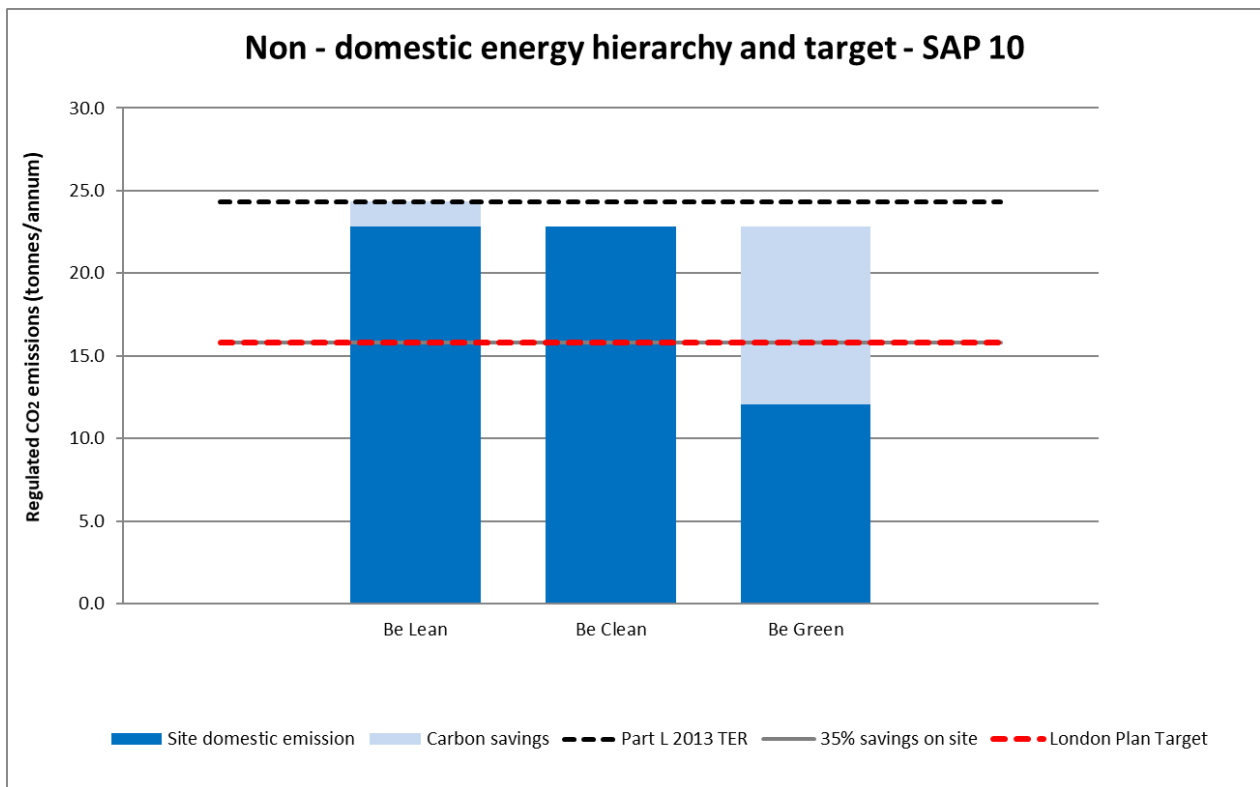


FIGURE 6 - FINAL RESIDENTIAL CO2 EMISSIONS FOR THE ENTIRE SITE

NOTES:

All outputs are based on initial design stage SAP/SBEM assessments for the development and need to be confirmed by final design SAP/SBEM calculations once they have been completed for the development.

SAPs have been based on Part L 2013 Building Regulations.

Examination of roof areas and photovoltaic module specification with manufacturer's details and requirements has been carried out.

11 SAP DATASHEETS

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	21DES_BS_11			Issued on Date	10/05/2021
Assessment Reference	Be Green (ASHP + PV)	Prop Type Ref	1B2P, Exp/Mid Flr		
Property	Plot '11', 86 Broad Street, Reading, Berkshire, RG1 2AP				
SAP Rating	84 B	DER	22.51	TER	27.74
Environmental	85 B	% DER<TER	18.84		
CO ₂ Emissions (t/year)	1.05	DFEE	37.38	TFEE	48.88
General Requirements Compliance	Pass	% DFEE<TFEE	23.53		
Assessor Details	Mr. Fulvio Vacca, Fulvio Vacca, Tel: 01924368145, softwaremanager@pellfrischmann.com			Assessor ID	W966-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 60 m²

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

1a TER and DER

Fuel for main heating: Electricity
Fuel factor: 1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.74 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 22.51 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 37.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified ψ -value of 0.080

3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

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

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.00 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, TRVs and bypass OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North East: 6.49 m², No overhang
Windows facing South: 7.21 m², No overhang
Windows facing North West: 1.17 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Party wall U-value 0.00 W/m²K
Air permeability 3.0 m³/m²h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1163 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			14.8700	1.3258	19.7140		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
Floor Above Communal Area			33.8400	0.1500	5.0760	80.0000	2707.2000 (28b)
External Wall	37.2300	16.9900	20.2400	0.1800	3.6432	110.0000	2226.4000 (29a)
Total net area of external elements Aum(A, m ²)			72.7300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	31.6502	(33)
Party Wall with 85			24.1800	0.0000	0.0000	70.0000	1692.6000 (32)
Party Wall with Flat			24.9100	0.0000	0.0000	20.0000	498.2000 (32)
Floor Above Retail			24.0100			80.0000	1920.8000 (32d)
Party Ceiling			59.5100			80.0000	4760.8000 (32b)
Internal Walls			78.2100			9.0000	703.8900 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =	14642.6900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							246.0543 (35)
Thermal Bridges (User defined value 0.080 * total exposed area)							5.8184 (36)
Total fabric heat loss					(33) + (36) =		37.4686 (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	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316 (38)
Heat transfer coeff	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002 (39)
Average = Sum(39)m / 12 =												62.9002 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570 (40)
HLP (average)												1.0570 (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												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	89.0274	85.7900	82.5527	79.3153	76.0779	72.8406	72.8406	76.0779	79.3153	82.5527	85.7900	89.0274 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Distribution loss (46)m = 0.15 x (45)m	19.8038	17.3205	17.8732	15.5823	14.9516	12.9021	11.9557	13.7193	13.8832	16.1795	17.6612	19.1789 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (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)
Output from w/h	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
Heat gains from water heating, kWh/month	75.9002	67.2987	71.6208	65.5103	65.1446	59.5692	58.5036	62.4130	61.7439	67.8664	70.1185	74.5151 (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	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.3080	13.5965	11.0574	8.3711	6.2575	5.2829	5.7083	7.4199	9.9590	12.6452	14.7588	15.7335 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.7095	173.4913	169.0012	159.4423	147.3759	136.0352	128.4590	126.6771	131.1672	140.7261	152.7925	164.1332 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387 (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)	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Water heating gains (Table 5)	102.0165	100.1469	96.2646	90.9866	87.5599	82.7350	78.6339	83.8885	85.7554	91.2183	97.3868	100.1547 (72)
Total internal gains	341.5501	339.7508	328.8393	311.3162	293.7096	276.5693	265.3174	270.5017	279.3979	297.1058	317.4543	332.5376 (73)

6. Solar gains

[Jan]													
					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast					6.4900	11.2829		0.6300	0.7000		0.7700		22.3789 (75)
South					7.2100	46.7521		0.6300	0.7000		0.7700		103.0168 (78)
Northwest					1.1700	11.2829		0.6300	0.7000		0.7700		4.0344 (81)
Solar gains	129.4301	222.4800	311.7804	401.9825	466.9555	471.5654	451.2685	401.1513	342.5365	247.6800	155.3448	110.5864	(83)
Total gains	470.9802	562.2308	640.6197	713.2987	760.6651	748.1347	716.5859	671.6530	621.9343	544.7859	472.7991	443.1240	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645
alpha	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110
util living area	0.9922	0.9800	0.9489	0.8675	0.7146	0.5287	0.3847	0.4280	0.6630	0.9076	0.9821	0.9942 (86)
Tweekday	19.0643	19.2856	19.5670	19.8399	19.9898	20.0307	20.0356	20.0352	20.0169	19.8196	19.3822	19.0036
Tweekend	20.3870	20.5147	20.6803	20.8504	20.9565	20.9926	20.9989	20.9980	20.9773	20.8321	20.5690	20.3523
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (88)
util rest of house	0.9898	0.9741	0.9345	0.8338	0.6565	0.4531	0.3013	0.3398	0.5837	0.8753	0.9758	0.9924 (89)
Tweekday	19.0643	19.2856	19.5670	19.8399	19.9898	20.0307	20.0356	20.0352	20.0169	19.8196	19.3822	19.0036
Tweekend	19.4857	19.6111	19.7704	19.9250	20.0099	20.0331	20.0359	20.0356	20.0253	19.9135	19.6658	19.4514
MIT 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (90)
Living area fraction									fLA = Living area / (4) =			0.6543 (91)
MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (92)
Temperature adjustment												0.0000
adjusted MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (93)

8. Space heating requirement

Utilisation	0.9914	0.9781	0.9444	0.8567	0.6953	0.5030	0.3560	0.3977	0.6367	0.8975	0.9801	0.9937 (94)
Useful gains	466.9358	549.9370	604.9714	611.0583	528.9250	376.2932	255.1114	267.1467	395.9814	488.9514	463.4120	440.3201 (95)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1029.4772	991.7371	891.0968	740.1363	564.0157	381.6050	255.8046	268.3847	413.0552	633.2059	853.3566	1035.7673 (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	418.5309	296.8897	212.8773	92.9361	26.1075	0.0000	0.0000	0.0000	0.0000	107.3253	280.7601	443.0127 (98)
Space heating												1878.4396 (98)
Space heating per m2											(98) / (4) =	31.5651 (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 %)												139.5310 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1346.2527 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	418.5309	296.8897	212.8773	92.9361	26.1075	0.0000	0.0000	0.0000	0.0000	107.3253	280.7601	443.0127 (98)
Space heating efficiency (main heating system 1)	139.5310	139.5310	139.5310	139.5310	139.5310	0.0000	0.0000	0.0000	0.0000	139.5310	139.5310	139.5310 (210)
Space heating fuel (main heating system)	299.9555	212.7769	152.5663	66.6061	18.7109	0.0000	0.0000	0.0000	0.0000	76.9187	201.2170	317.5013 (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	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (217)
Fuel for water heating, kWh/month	91.0415	80.2313	84.2301	75.4645	73.9221	66.0082	63.3520	69.5744	69.4696	78.2544	82.7991	88.8368 (219)
Water heating fuel used												923.1842 (219)
Annual totals kWh/year												
Space heating fuel - main system												1346.2527 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												41.5568 (230a)
Total electricity for the above, kWh/year												41.5568 (231)
Electricity for lighting (calculated in Appendix L)												270.3445 (232)
Total delivered energy for all uses												2581.3381 (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	1346.2527	0.5190	698.7052 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	923.1842	0.5190	479.1326 (264)
Space and water heating			1177.8377 (265)
Pumps and fans	41.5568	0.5190	21.5680 (267)
Energy for lighting	270.3445	0.5190	140.3088 (268)
Total CO2, kg/year			1339.7145 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			22.5100 (273)

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

DER			22.5100 ZC1
Total Floor Area		TFA	59.5100
Assumed number of occupants		N	1.9677
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.0982 ZC2
CO2 emissions from cooking, equation (L16)			2.7932 ZC3
Total CO2 emissions			42.4014 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			42.4014 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					20.0000 / (5) = 0.1298 (8)
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.3798 (18)
					3 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2943 (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												
Effective ac	0.3753	0.3679	0.3605	0.3237	0.3164	0.2796	0.2796	0.2722	0.2943	0.3164	0.3311	0.3458 (22b)
Effective ac	0.5704	0.5677	0.5650	0.5524	0.5501	0.5391	0.5391	0.5371	0.5433	0.5501	0.5548	0.5598 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			12.7500	1.3258	16.9034		(27)
Floor Above Street			1.6600	0.1300	0.2158		(28b)
Floor Above Communal Area			33.8400	0.1300	4.3992		(28b)
External Wall	37.2300	14.8700	22.3600	0.1800	4.0248		(29a)
Total net area of external elements Aum(A, m ²)			72.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.6632		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.9651 (36)
Total fabric heat loss						(33) + (36) =	39.6283 (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	29.0127	28.8736	28.7373	28.0971	27.9773	27.4197	27.4197	27.3165	27.6345	27.9773	28.2196	28.4730 (38)
Heat transfer coeff	68.6410	68.5019	68.3656	67.7254	67.6056	67.0480	67.0480	66.9448	67.2628	67.6056	67.8480	68.1013 (39)
Average = Sum(39)m / 12 =												67.7248 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1534	1.1511	1.1488	1.1381	1.1360	1.1267	1.1267	1.1249	1.1303	1.1360	1.1401	1.1444 (40)
HLP (average)												1.1380 (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												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
Daily hot water use	89.0274	85.7900	82.5527	79.3153	76.0779	72.8406	72.8406	76.0779	79.3153	82.5527	85.7900	89.0274 (44)
Energy conte	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Energy content (annual)										Total = Sum(45)m =		1273.4066 (45)
Distribution loss (46)m = 0.15 x (45)m	19.8038	17.3205	17.8732	15.5823	14.9516	12.9021	11.9557	13.7193	13.8832	16.1795	17.6612	19.1789 (46)
Water storage loss:												170.0000 (47)
Store volume												1.5003 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8102 (55)
Enter (49) or (54) in (55)												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (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	180.4027	159.1659	167.5323	150.6990	148.0549	132.8309	128.0821	139.8397	139.3715	156.2409	164.5582	176.2369 (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)
Output from w/h	180.4027	159.1659	167.5323	150.6990	148.0549	132.8309	128.0821	139.8397	139.3715	156.2409	164.5582	176.2369 (64)
Heat gains from water heating, kWh/month	82.6005	73.3505	78.3211	71.9944	71.8448	66.0533	65.2039	69.1133	68.2280	74.5667	76.6026	81.2153 (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	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.3308	13.6167	11.0739	8.3836	6.2669	5.2907	5.7168	7.4310	9.9738	12.6641	14.7808	15.7569 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.7095	173.4913	169.0012	159.4423	147.3759	136.0352	128.4590	126.6771	131.1672	140.7261	152.7925	164.1332 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387 (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)	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Water heating gains (Table 5)	111.0222	109.1526	105.2703	99.9923	96.5656	91.7407	87.6396	92.8942	94.7611	100.2240	106.3925	109.1604 (72)
Total internal gains	353.5787	351.7768	340.8615	323.3344	305.7246	288.5829	277.3316	282.5185	291.4184	309.1304	329.4820	344.5667 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
Northeast				5.5600	11.2829	0.6300	0.7000			0.7700			19.1721 (75)
South				6.1900	46.7521	0.6300	0.7000			0.7700			88.4430 (78)
Northwest				1.0000	11.2829	0.6300	0.7000			0.7700			3.4482 (81)
Solar gains	111.0632	190.8910	267.4662	344.7747	400.4391	404.3667	386.9726	344.0377	293.8260	212.5005	133.2972	94.8957	(83)
Total gains	464.6419	542.6678	608.3277	668.1091	706.1637	692.9495	664.3042	626.5562	585.2444	521.6309	462.7793	439.4624	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	60.2066	60.3288	60.4491	61.0205	61.1286	61.6370	61.6370	61.7321	61.4402	61.1286	60.9103	60.6837
alpha	5.0138	5.0219	5.0299	5.0680	5.0752	5.1091	5.1091	5.1155	5.0960	5.0752	5.0607	5.0456
util living area	0.9935	0.9854	0.9650	0.9076	0.7834	0.5977	0.4402	0.4848	0.7265	0.9322	0.9859	0.9951 (86)
MIT	19.9202	20.1035	20.3619	20.6630	20.8805	20.9764	20.9959	20.9934	20.9383	20.6570	20.2303	19.8834 (87)
Th 2	19.9574	19.9593	19.9612	19.9699	19.9715	19.9791	19.9791	19.9805	19.9762	19.9715	19.9682	19.9648 (88)
util rest of house	0.9915	0.9808	0.9540	0.8793	0.7253	0.5114	0.3401	0.3808	0.6427	0.9050	0.9807	0.9935 (89)
MIT 2	18.5389	18.8053	19.1752	19.5941	19.8626	19.9646	19.9777	19.9780	19.9319	19.5972	18.9974	18.4908 (90)
Living area fraction	19.4427	19.6548	19.9517	20.2935	20.5286	20.6266	20.6439	20.6424	20.5904	20.2907	19.8042	19.4020 (92)
Temperature adjustment	19.4427	19.6548	19.9517	20.2935	20.5286	20.6266	20.6439	20.6424	20.5904	20.2907	19.8042	19.4020 (93)
adjusted MIT	19.4427	19.6548	19.9517	20.2935	20.5286	20.6266	20.6439	20.6424	20.5904	20.2907	19.8042	19.4020 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9902	0.9791	0.9538	0.8891	0.7582	0.5671	0.4057	0.4489	0.6948	0.9145	0.9796	0.9923 (94)
Ext temp.	460.0700	531.3397	580.2435	593.9950	535.3792	392.9534	269.4819	281.2724	406.6478	477.0206	453.3550	436.0912 (95)
Heat loss rate W	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)
Month fracti	1039.4131	1010.7328	919.6341	771.6313	596.8663	404.0733	271.1372	284.0058	436.5651	655.1427	861.9516	1035.2789 (97)
Space heating kWh	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	431.0313	322.1521	252.5066	127.8981	45.7463	0.0000	0.0000	0.0000	0.0000	132.5229	294.1896	445.7956 (98)
Space heating per m2												2051.8426 (98)
										(98) / (4) =		34.4790 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2194.4841 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	431.0313	322.1521	252.5066	127.8981	45.7463	0.0000	0.0000	0.0000	0.0000	132.5229	294.1896	445.7956	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	460.9961	344.5478	270.0605	136.7894	48.9266	0.0000	0.0000	0.0000	0.0000	141.7357	314.6413	476.7868	(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 requirement	180.4027	159.1659	167.5323	150.6990	148.0549	132.8309	128.0821	139.8397	139.3715	156.2409	164.5582	176.2369	(64)
Efficiency of water heater (217)m	87.0559	86.6576	85.9058	84.3800	82.0910	79.8000	79.8000	79.8000	79.8000	84.3784	86.3469	87.1878	(216)
Fuel for water heating, kWh/month	207.2263	183.6723	195.0187	178.5957	180.3545	166.4548	160.5039	175.2377	174.6510	185.1669	190.5780	202.1349	(219)
Water heating fuel used													2199.5946 (219)
Annual totals kWh/year													
Space heating fuel - main system													2194.4841 (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)													270.7476 (232)
Total delivered energy for all uses													4739.8263 (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	2194.4841	0.2160	474.0086 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2199.5946	0.2160	475.1124 (264)
Space and water heating			949.1210 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	270.7476	0.5190	140.5180 (268)
Total CO2, kg/m2/year			1128.5640 (272)
Emissions per m2 for space and water heating			15.9489 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.3613 (272b)
Emissions per m2 for pumps and fans			0.6541 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9489 * 1.55) + 2.3613 + 0.6541, rounded to 2 d.p.			27.7400 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour
Pressure test					20.0000 / (5) = 0.1298 (8)
Measured/design AP50					Yes
Infiltration rate					3.0000
Number of sides sheltered					0.2798 (18)
					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2168 (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												
Effective ac	0.2764	0.2710	0.2656	0.2385	0.2331	0.2060	0.2060	0.2006	0.2168	0.2331	0.2439	0.2548 (22b)
	0.5382	0.5367	0.5353	0.5284	0.5272	0.5212	0.5212	0.5201	0.5235	0.5272	0.5297	0.5325 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			14.8700	1.3258	19.7140		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
Floor Above Communal Area			33.8400	0.1500	5.0760	80.0000	2707.2000 (28b)
External Wall	37.2300	16.9900	20.2400	0.1800	3.6432	110.0000	2226.4000 (29a)
Total net area of external elements Aum(A, m ²)			72.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6502		(33)
Party Wall with 85			24.1800	0.0000	0.0000	70.0000	1692.6000 (32)
Party Wall with Flat			24.9100	0.0000	0.0000	20.0000	498.2000 (32)
Floor Above Retail			24.0100			80.0000	1920.8000 (32d)
Party Ceiling			59.5100			100.0000	5951.0000 (32b)
Internal Walls			78.2100			9.0000	703.8900 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 15832.8900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							266.0543 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							5.8184 (36)
Total fabric heat loss						(33) + (36) =	37.4686 (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	27.3750	27.2996	27.2256	26.8781	26.8131	26.5105	26.5105	26.4545	26.6271	26.8131	26.9446	27.0821 (38)
Heat transfer coeff	64.8436	64.7682	64.6942	64.3468	64.2818	63.9791	63.9791	63.9231	64.0957	64.2818	64.4133	64.5507 (39)
Average = Sum(39)m / 12 =												64.3465 (39)
HLP	1.0896	1.0884	1.0871	1.0813	1.0802	1.0751	1.0751	1.0742	1.0771	1.0802	1.0824	1.0847 (40)
HLP (average)												1.0813 (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												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
Daily hot water use	89.0274	85.7900	82.5527	79.3153	76.0779	72.8406	72.8406	76.0779	79.3153	82.5527	85.7900	89.0274 (44)
Energy conte	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Energy content (annual)										Total = Sum(45)m =		1273.4066 (45)
Distribution loss (46)m = 0.15 x (45)m												

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	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	28.0553	24.5374	25.3204	22.0749	21.1814	18.2779	16.9372	19.4357	19.6678	22.9209	25.0200	27.1701 (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	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.3080	13.5965	11.0574	8.3711	6.2575	5.2829	5.7083	7.4199	9.9590	12.6452	14.7588	15.7335	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.7095	173.4913	169.0012	159.4423	147.3759	136.0352	128.4590	126.6771	131.1672	140.7261	152.7925	164.1332	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	(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)	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	(71)
Water heating gains (Table 5)	37.7088	36.5139	34.0327	30.6596	28.4696	25.3860	22.7650	26.1232	27.3164	30.8077	34.7500	36.5189	(72)
Total internal gains	277.2424	276.1178	266.6075	250.9892	234.6193	219.2203	209.4485	212.7365	220.9588	236.6952	254.8175	268.9018	(73)

6. Solar gains

[Jan]														
	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
Northeast	6.4900				11.2829		0.6300		0.7000		0.7700		22.3789 (75)	
South	7.2100				46.7521		0.6300		0.7000		0.7700		103.0168 (78)	
Northwest	1.1700				11.2829		0.6300		0.7000		0.7700		4.0344 (81)	
Solar gains	129.4301	222.4800	311.7804	401.9825	466.9555	471.5654	451.2685	401.1513	342.5365	247.6800	155.3448	110.5864	(83)	
Total gains	406.6725	498.5978	578.3879	652.9718	701.5748	690.7857	660.7170	613.8877	563.4953	484.3753	410.1623	379.4882	(84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	67.8251	67.9041	67.9817	68.3488	68.4179	68.7415	68.7415	68.8018	68.6165	68.4179	68.2783	68.1328	
alpha	5.5217	5.5269	5.5321	5.5566	5.5612	5.5828	5.5828	5.5868	5.5744	5.5612	5.5519	5.5422	
util living area	0.9972	0.9911	0.9724	0.9113	0.7725	0.5793	0.4240	0.4749	0.7299	0.9478	0.9929	0.9981	(86)
MIT	19.9719	20.1671	20.4296	20.7210	20.9151	20.9859	20.9979	20.9962	20.9529	20.6816	20.2582	19.9280	(87)
Th 2	20.0093	20.0104	20.0114	20.0162	20.0170	20.0212	20.0212	20.0220	20.0196	20.0170	20.0152	20.0133	(88)
util rest of house	0.9962	0.9881	0.9631	0.8833	0.7140	0.4967	0.3308	0.3761	0.6471	0.9247	0.9899	0.9974	(89)
MIT 2	19.0781	19.2725	19.5299	19.8056	19.9657	20.0155	20.0208	20.0210	19.9972	19.7777	19.3680	19.0377	(90)
Living area fraction									fLA = Living area / (4) =			0.6543	(91)
MIT	19.6630	19.8579	20.1186	20.4046	20.5869	20.6505	20.6601	20.6591	20.6226	20.3692	19.9505	19.6202	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6630	19.8579	20.1186	20.4046	20.5869	20.6505	20.6601	20.6591	20.6226	20.3692	19.9505	19.6202	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	404.9578	492.3590	557.6992	584.5983	525.5497	380.2415	258.9029	270.6342	394.2957	452.4181	405.9239	378.3650	(94)
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	996.1909	968.7956	881.0458	740.2851	571.2685	387.1035	259.7642	272.2550	418.0677	627.9783	827.7426	995.3877	(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	439.8774	320.1654	240.5698	112.0945	34.0148	0.0000	0.0000	0.0000	0.0000	130.6168	303.7095	459.0649	(98)
Space heating												2040.1131	(98)
Space heating per m2												34.2819	(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	601.4040	473.4457	485.8156	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9590	0.9822	0.9736	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	576.7521	465.0305	472.9756	0.0000	0.0000	0.0000	0.0000	(102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	880.9403	844.3515	790.7506	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	219.0155	282.2148	236.4246	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												737.6549 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	54.7539	70.5537	59.1061	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												184.4137 (107)
Space cooling per m2												3.0989 (108)
Energy for space heating												34.2819 (99)
Energy for space cooling												3.0989 (108)
Total												37.3807 (109)
Dwelling Fabric Energy Efficiency (DFEE)												37.4 (109)

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Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				20.0000 / (5) = 0.1298 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3798 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2943 (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												
Effective ac	0.3753	0.3679	0.3605	0.3237	0.3164	0.2796	0.2796	0.2722	0.2943	0.3164	0.3311	0.3458 (22b)
Effective ac	0.5704	0.5677	0.5650	0.5524	0.5501	0.5391	0.5391	0.5371	0.5433	0.5501	0.5548	0.5598 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			12.7500	1.3258	16.9034		(27)
Floor Above Street			1.6600	0.1300	0.2158		(28b)
Floor Above Communal Area			33.8400	0.1300	4.3992		(28b)
External Wall	37.2300	14.8700	22.3600	0.1800	4.0248		(29a)
Total net area of external elements Aum(A, m ²)			72.7300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	27.6632	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.9651 (36)
Total fabric heat loss						(33) + (36) =	39.6283 (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	29.0127	28.8736	28.7373	28.0971	27.9773	27.4197	27.4197	27.3165	27.6345	27.9773	28.2196	28.4730 (38)
Heat transfer coeff	68.6410	68.5019	68.3656	67.7254	67.6056	67.0480	67.0480	66.9448	67.2628	67.6056	67.8480	68.1013 (39)
Average = Sum(39)m / 12 =												67.7248 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1534	1.1511	1.1488	1.1381	1.1360	1.1267	1.1267	1.1249	1.1303	1.1360	1.1401	1.1444 (40)
HLP (average)												1.1380 (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												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	89.0274	85.7900	82.5527	79.3153	76.0779	72.8406	72.8406	76.0779	79.3153	82.5527	85.7900	89.0274 (44)
Energy conte	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Energy content (annual)										Total = Sum(45)m =		1273.4066 (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	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)

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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	28.0553	24.5374	25.3204	22.0749	21.1814	18.2779	16.9372	19.4357	19.6678	22.9209	25.0200	27.1701 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873	98.3873 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	15.3308	13.6167	11.0739	8.3836	6.2669	5.2907	5.7168	7.4310	9.9738	12.6641	14.7808	15.7569 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	171.7095	173.4913	169.0012	159.4423	147.3759	136.0352	128.4590	126.6771	131.1672	140.7261	152.7925	164.1332 (68)
Pumps, fans	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387	32.8387 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Total internal gains	37.7088	36.5139	34.0327	30.6596	28.4696	25.3860	22.7650	26.1232	27.3164	30.8077	34.7500	36.5189 (72)
	277.2653	276.1381	266.6240	251.0017	234.6286	219.2282	209.4570	212.7475	220.9736	236.7141	254.8395	268.9252 (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	
Northeast		5.5600	11.2829	0.6300	0.7000	0.7700	19.1721 (75)
South		6.1900	46.7521	0.6300	0.7000	0.7700	88.4430 (78)
Northwest		1.0000	11.2829	0.6300	0.7000	0.7700	3.4482 (81)

Solar gains	111.0632	190.8910	267.4662	344.7747	400.4391	404.3667	386.9726	344.0377	293.8260	212.5005	133.2972	94.8957 (83)
Total gains	388.3285	467.0291	534.0901	595.7764	635.0677	623.5949	596.4296	556.7852	514.7997	449.2146	388.1367	363.8210 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	60.2066	60.3288	60.4491	61.0205	61.1286	61.6370	61.6370	61.7321	61.4402	61.1286	60.9103	60.6837
util living area	5.0138	5.0219	5.0299	5.0680	5.0752	5.1091	5.1091	5.1155	5.0960	5.0752	5.0607	5.0456
	0.9971	0.9923	0.9789	0.9366	0.8312	0.6527	0.4877	0.5408	0.7898	0.9602	0.9934	0.9979 (86)
MIT	19.8028	19.9910	20.2605	20.5864	20.8404	20.9650	20.9934	20.9892	20.9089	20.5700	20.1186	19.7661 (87)
Th 2	19.9574	19.9593	19.9612	19.9699	19.9715	19.9791	19.9791	19.9805	19.9762	19.9715	19.9682	19.9648 (88)
util rest of house	0.9961	0.9897	0.9718	0.9148	0.7781	0.5629	0.3782	0.4272	0.7098	0.9420	0.9908	0.9972 (89)
MIT 2	18.8725	19.0609	19.3278	19.6462	19.8686	19.9639	19.9775	19.9776	19.9289	19.6386	19.1958	18.8419 (90)
Living area fraction	19.4812	19.6695	19.9381	20.2614	20.5045	20.6190	20.6423	20.6395	20.5702	20.2481	19.7996	19.4466 (92)
MIT												0.6543 (91)
Temperature adjustment												0.0000
adjusted MIT	19.4812	19.6695	19.9381	20.2614	20.5045	20.6190	20.6423	20.6395	20.5702	20.2481	19.7996	19.4466 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9955	0.9888	0.9716	0.9217	0.8072	0.6206	0.4500	0.5016	0.7587	0.9477	0.9902	0.9967 (94)
Ext temp.	386.5967	461.7979	518.9049	549.1184	512.6271	386.9856	268.3765	279.3102	390.5870	425.7092	384.3373	362.6288 (95)
Heat loss rate W	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)
Month fracti	1042.0526	1011.7412	918.7054	769.4570	595.2324	403.5601	271.0267	283.8131	435.2011	652.2649	861.6430	1038.3159 (97)
Space heating kWh	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	487.6592	369.5619	297.4515	158.6437	61.4583	0.0000	0.0000	0.0000	0.0000	168.5574	343.6602	502.7112 (98)
Space heating per m2												2389.7035 (98)
												(98) / (4) = 40.1563 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	630.2514	496.1554	508.7802	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9190	0.9594	0.9447	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	579.2067	476.0289	480.6445	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	802.4161	769.2217	724.0221	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	160.7108	218.1354	181.0730	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												559.9191 (104)
												fC = cooled area / (4) = 1.0000 (105)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)	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	40.1777	54.5339	45.2682	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											139.9798 (107)
Space cooling per m2											2.3522 (108)
Energy for space heating											40.1563 (99)
Energy for space cooling											2.3522 (108)
Total											42.5085 (109)
Target Fabric Energy Efficiency (TFEE)											48.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					0.0000 / (5) = 0.0000 (8)
Measured/design AP50					Yes
Infiltration rate					3.0000
Number of sides sheltered					0.1500 (18)
					3 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.1163 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			14.8700	1.3258	19.7140		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
Floor Above Communal Area			33.8400	0.1500	5.0760	80.0000	2707.2000 (28b)
External Wall	37.2300	16.9900	20.2400	0.1800	3.6432	110.0000	2226.4000 (29a)
Total net area of external elements Aum(A, m ²)			72.7300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6502		(33)
Party Wall with 85			24.1800	0.0000	0.0000	70.0000	1692.6000 (32)
Party Wall with Flat			24.9100	0.0000	0.0000	20.0000	498.2000 (32)
Floor Above Retail			24.0100			80.0000	1920.8000 (32d)
Party Ceiling			59.5100			80.0000	4760.8000 (32b)
Internal Walls			78.2100			9.0000	703.8900 (32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14642.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K		246.0543 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		5.8184 (36)
Total fabric heat loss	(33) + (36) =	37.4686 (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	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316	25.4316 (38)
Heat transfer coeff	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002	62.9002 (39)
Average = Sum(39)m / 12 =												62.9002 (39)
HLP	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570	1.0570 (40)
HLP (average)												1.0570 (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												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
Daily hot water use	89.0274	85.7900	82.5527	79.3153	76.0779	72.8406	72.8406	76.0779	79.3153	82.5527	85.7900	89.0274 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Energy content (annual)										Total =	Sum (45)m =	1273.4066 (45)
Distribution loss (46)m = 0.15 x (45)m												
	19.8038	17.3205	17.8732	15.5823	14.9516	12.9021	11.9557	13.7193	13.8832	16.1795	17.6612	19.1789 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage												
	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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												
	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (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												
	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
										Total per year (kWh/year) =	Sum (64)m =	1744.4026 (64)
												1744 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month												
	75.9002	67.2987	71.6208	65.5103	65.1446	59.5692	58.5036	62.4130	61.7439	67.8664	70.1185	74.5151 (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	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	38.2701	33.9911	27.6434	20.9279	15.6438	13.2072	14.2708	18.5498	24.8974	31.6130	36.8971	39.3337 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	256.2828	258.9422	252.2406	237.9736	219.9641	203.0377	191.7298	189.0704	195.7720	210.0390	228.0485	244.9749 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742 (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)												
	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Water heating gains (Table 5)												
	102.0165	100.1469	96.2646	90.9866	87.5599	82.7350	78.6339	83.8885	85.7554	91.2183	97.3868	100.1547 (72)
Total internal gains												
	484.6984	481.2094	464.2777	438.0172	411.2969	387.1090	372.7637	379.6378	394.5540	420.9995	450.4615	472.5925 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				6.4900	13.7804	0.6300	0.7000	0.7700	27.3325 (75)			
South				7.2100	54.2217	0.6300	0.7000	0.7700	119.4759 (78)			
Northwest				1.1700	13.7804	0.6300	0.7000	0.7700	4.9274 (81)			
Solar gains	151.7358	228.1924	318.8705	420.5773	478.9048	512.8153	485.4137	440.3220	374.5099	273.0027	179.4419	130.3811 (83)
Total gains	636.4342	709.4018	783.1482	858.5945	890.2018	899.9243	858.1774	819.9598	769.0639	694.0022	629.9034	602.9735 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645
alpha	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110
util living area												
	0.9650	0.9391	0.8762	0.7437	0.5593	0.3624	0.2418	0.2607	0.4850	0.7726	0.9288	0.9718 (86)
Tweekday	19.4210	19.5785	19.7931	19.9621	20.0251	20.0356	20.0361	20.0361	20.0330	19.9642	19.6924	19.3711
Tweekend	20.5943	20.6887	20.8221	20.9373	20.9878	20.9990	20.9999	20.9999	20.9953	20.9355	20.7555	20.5647
24 / 16												
	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9												
	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9												
	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (88)
util rest of house												
	0.9554	0.9235	0.8477	0.6961	0.4976	0.2958	0.1712	0.1869	0.4097	0.7178	0.9079	0.9638 (89)
Tweekday	19.4210	19.5785	19.7931	19.9621	20.0251	20.0356	20.0361	20.0361	20.0330	19.9642	19.6924	19.3711
Tweekend	19.6877	19.7769	19.8985	19.9942	20.0299	20.0358	20.0361	20.0361	20.0344	19.9954	19.8415	19.6595
MIT 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (90)
Living area fraction												
									fLA = Living area / (4) =			0.6543 (91)
MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (92)
Temperature adjustment												0.0000
adjusted MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9620	0.9341	0.8670	0.7279	0.5383	0.3394	0.2174	0.2352	0.4593	0.7547	0.9222	0.9693 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Useful gains	612.2352	662.6642	678.9901	624.9753	479.2193	305.4662	186.5702	192.8366	353.1995	523.7294	580.9134	584.4612 (95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W												
Month fracti	979.1571	941.4169	834.4866	677.2361	488.5354	306.1248	186.6144	192.9044	356.4450	576.5957	796.7465	979.1571 (97)
Space heating kWh	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	272.9899	187.3218	115.6894	37.6277	6.9312	0.0000	0.0000	0.0000	0.0000	39.3325	155.3998	293.6538 (98)
RHI space heating demand												1108.9461 (98)
												1109 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main		secondary		other		total	m3 per hour				
	heating		heating									
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							0 * 10 =	0.0000	(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) =						0.0000 / (5) =	0.0000	(8)			
Pressure test							Yes					
Measured/design AP50								3.0000				
Infiltration rate								0.1500	(18)			
Number of sides sheltered								3	(19)			
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.7750	(20)			
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.1163	(21)			
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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	
Entrance Doors			2.1200	1.4000	2.9680			(26)
Windows & Glazed Doors (Uw = 1.40)			14.8700	1.3258	19.7140			(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000	(28b)
Floor Above Communal Area			33.8400	0.1500	5.0760	80.0000	2707.2000	(28b)
External Wall	37.2300	16.9900	20.2400	0.1800	3.6432	110.0000	2226.4000	(29a)
Total net area of external elements Aum(A, m2)			72.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6502			(33)
Party Wall with 85			24.1800	0.0000	0.0000	70.0000	1692.6000	(32)
Party Wall with Flat			24.9100	0.0000	0.0000	20.0000	498.2000	(32)
Floor Above Retail			24.0100			80.0000	1920.8000	(32d)
Party Ceiling			59.5100			80.0000	4760.8000	(32b)
Internal Walls			78.2100			9.0000	703.8900	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14642.6900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							246.0543	(35)
Thermal bridges (User defined value 0.080 * total exposed area)							5.8184	(36)
Total fabric heat loss						(33) + (36) =	37.4686	(37)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
Daily hot water use	Jan 89.0274	Feb 85.7900	Mar 82.5527	Apr 79.3153	May 76.0779	Jun 72.8406	Jul 72.8406	Aug 76.0779	Sep 79.3153	Oct 82.5527	Nov 85.7900	Dec 89.0274 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Distribution loss (46)m = 0.15 x (45)m	19.8038	17.3205	17.8732	15.5823	14.9516	12.9021	11.9557	13.7193	13.8832	16.1795	17.6612	19.1789 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (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)
Output from w/h	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
Heat gains from water heating, kWh/month	75.9002	67.2987	71.6208	65.5103	65.1446	59.5692	58.5036	62.4130	61.7439	67.8664	70.1185	74.5151 (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	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.2701	33.9911	27.6434	20.9279	15.6438	13.2072	14.2708	18.5498	24.8974	31.6130	36.8971	39.3337 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.2828	258.9422	252.2406	237.9736	219.9641	203.0377	191.7298	189.0704	195.7720	210.0390	228.0485	244.9749 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742 (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)	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Water heating gains (Table 5)	102.0165	100.1469	96.2646	90.9866	87.5599	82.7350	78.6339	83.8885	85.7554	91.2183	97.3868	100.1547 (72)
Total internal gains	484.6984	481.2094	464.2777	438.0172	411.2969	387.1090	372.7637	379.6378	394.5540	420.9995	450.4615	472.5925 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				6.4900	11.2829	0.6300	0.7000	0.7700	22.3789 (75)			
South				7.2100	46.7521	0.6300	0.7000	0.7700	103.0168 (78)			
Northwest				1.1700	11.2829	0.6300	0.7000	0.7700	4.0344 (81)			
Solar gains	129.4301	222.4800	311.7804	401.9825	466.9555	471.5654	451.2685	401.1513	342.5365	247.6800	155.3448	110.5864 (83)
Total gains	614.1285	703.6893	776.0581	839.9997	878.2525	858.6744	824.0322	780.7890	737.0905	668.6795	605.8063	583.1789 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645
alpha	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110
util living area	0.9752	0.9509	0.9010	0.7973	0.6382	0.4643	0.3352	0.3694	0.5738	0.8322	0.9514	0.9805 (86)
Tweekday	19.3028	19.4948	19.7203	19.9155	20.0098	20.0332	20.0359	20.0357	20.0268	19.9118	19.5793	19.2427
Tweekend	20.5253	20.6389	20.7763	20.9040	20.9743	20.9959	20.9994	20.9990	20.9883	20.8973	20.6668	20.4903
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (88)
util rest of house	0.9684	0.9385	0.8778	0.7565	0.5809	0.3964	0.2621	0.2926	0.4997	0.7875	0.9369	0.9750 (89)
Tweekday	19.3028	19.4948	19.7203	19.9155	20.0098	20.0332	20.0359	20.0357	20.0268	19.9118	19.5793	19.2427
Tweekend	19.6208	19.7296	19.8572	19.9678	20.0212	20.0345	20.0360	20.0359	20.0308	19.9657	19.7774	19.5868
MIT 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (90)
Living area fraction									fLA = Living area / (4) =			0.6543 (91)
MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (92)
Temperature adjustment												0.0000
adjusted MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9730	0.9470	0.8935	0.7839	0.6189	0.4411	0.3100	0.3430	0.5487	0.8177	0.9469	0.9788 (94)
	597.5519	666.3693	693.4449	658.4676	543.5573	378.7318	255.4510	267.7776	404.4515	546.8087	573.6178	570.7882 (95)

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Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1029.4772	991.7371	891.0968	740.1363	564.0157	381.6050	255.8046	268.3847	413.0552	633.2059	853.3566	1035.7673 (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	321.3524	218.6471	147.0530	58.8015	15.2211	0.0000	0.0000	0.0000	0.0000	64.2795	201.4120	345.9445 (98)
Space heating												1372.7110 (98)
Space heating per m2											(98) / (4) =	23.0669 (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 %)												139.5310 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												983.8038 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	321.3524	218.6471	147.0530	58.8015	15.2211	0.0000	0.0000	0.0000	0.0000	64.2795	201.4120	345.9445 (98)
Space heating efficiency (main heating system 1)	139.5310	139.5310	139.5310	139.5310	139.5310	0.0000	0.0000	0.0000	0.0000	139.5310	139.5310	139.5310 (210)
Space heating fuel (main heating system)	230.3090	156.7015	105.3909	42.1422	10.9087	0.0000	0.0000	0.0000	0.0000	46.0683	144.3493	247.9338 (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	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (217)
Fuel for water heating, kWh/month	91.0415	80.2313	84.2301	75.4645	73.9221	66.0082	63.3520	69.5744	69.4696	78.2544	82.7991	88.8368 (219)
Water heating fuel used												923.1842 (219)
Annual totals kWh/year												
Space heating fuel - main system												983.8038 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												41.5568 (230a)
Total electricity for the above, kWh/year												41.5568 (231)
Electricity for lighting (calculated in Appendix L)												270.3445 (232)
Total delivered energy for all uses												2218.8892 (238)

10a. Fuel costs - using Table 12 prices

	Fuel	Fuel price	Fuel cost
	kWh/year	p/kWh	£/year
Space heating - main system 1	983.8038	13.1900	129.7637 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	923.1842	13.1900	121.7680 (247)
Mechanical ventilation fans	41.5568	13.1900	5.4813 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	270.3445	13.1900	35.6584 (250)
Additional standing charges			0.0000 (251)
Total energy cost			292.6715 (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] =	1.1762 (257)
SAP value		83.5924
SAP rating (Section 12)		84 (258)
SAP band		B

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

	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	983.8038	0.5190	510.5942 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	923.1842	0.5190	479.1326 (264)
Space and water heating			989.7267 (265)
Pumps and fans	41.5568	0.5190	21.5680 (267)
Energy for lighting	270.3445	0.5190	140.3088 (268)
Total kg/year			1151.6035 (272)
CO2 emissions per m2			19.3500 (273)
EI value			85.2344
EI rating			85 (274)
EI band			B

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.00) / 1.3953 = 9.453$, stars = 2
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 1.3953 = 0.3720$, stars = 3
Water heating energy efficiency	$13.19 / 1.8896 = 6.980$, stars = 3
Water heating environmental impact	$0.519 / 1.8896 = 0.2747$, stars = 4

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Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	59.5100 (1b)	x 2.5900 (2b)	= 154.1309 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.5100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 154.1309 (5)

2. Ventilation rate

	main		secondary		other		total	m3 per hour				
	heating		heating									
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							0 * 10 =	0.0000	(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) =						0.0000 / (5) =	0.0000	(8)			
Pressure test							Yes					
Measured/design AP50							3.0000					
Infiltration rate							0.1500		(18)			
Number of sides sheltered							3		(19)			
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.7750	(20)			
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.1163	(21)			
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
Entrance Doors			2.1200	1.4000	2.9680			(26)
Windows & Glazed Doors (Uw = 1.40)			14.8700	1.3258	19.7140			(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000	(28b)
Floor Above Communal Area			33.8400	0.1500	5.0760	80.0000	2707.2000	(28b)
External Wall	37.2300	16.9900	20.2400	0.1800	3.6432	110.0000	2226.4000	(29a)
Total net area of external elements Aum(A, m ²)			72.7300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6502			(33)
Party Wall with 85			24.1800	0.0000	0.0000	70.0000	1692.6000	(32)
Party Wall with Flat			24.9100	0.0000	0.0000	20.0000	498.2000	(32)
Floor Above Retail			24.0100			80.0000	1920.8000	(32d)
Party Ceiling			59.5100			80.0000	4760.8000	(32b)
Internal Walls			78.2100			9.0000	703.8900	(32c)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			14642.6900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							246.0543	(35)
Thermal bridges (User defined value 0.080 * total exposed area)							5.8184	(36)
Total fabric heat loss						(33) + (36) =	37.4686	(37)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9677 (42)
Average daily hot water use (litres/day)												80.9340 (43)
Daily hot water use	Jan 89.0274	Feb 85.7900	Mar 82.5527	Apr 79.3153	May 76.0779	Jun 72.8406	Jul 72.8406	Aug 76.0779	Sep 79.3153	Oct 82.5527	Nov 85.7900	Dec 89.0274 (44)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Energy conte	132.0250	115.4699	119.1546	103.8819	99.6771	86.0138	79.7044	91.4620	92.5543	107.8632	117.7411	127.8592 (45)
Energy content (annual)										Total = Sum (45)m =		1273.4066 (45)
Distribution loss (46)m = 0.15 x (45)m												
	19.8038	17.3205	17.8732	15.5823	14.9516	12.9021	11.9557	13.7193	13.8832	16.1795	17.6612	19.1789 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage												
	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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												
	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (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												
	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
										Total per year (kWh/year) = Sum (64)m =		1744.4026 (64)
Heat gains from water heating, kWh/month												
	75.9002	67.2987	71.6208	65.5103	65.1446	59.5692	58.5036	62.4130	61.7439	67.8664	70.1185	74.5151 (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	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648	118.0648 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	38.2701	33.9911	27.6434	20.9279	15.6438	13.2072	14.2708	18.5498	24.8974	31.6130	36.8971	39.3337 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	256.2828	258.9422	252.2406	237.9736	219.9641	203.0377	191.7298	189.0704	195.7720	210.0390	228.0485	244.9749 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742	48.7742 (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)												
	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099	-78.7099 (71)
Water heating gains (Table 5)												
	102.0165	100.1469	96.2646	90.9866	87.5599	82.7350	78.6339	83.8885	85.7554	91.2183	97.3868	100.1547 (72)
Total internal gains	484.6984	481.2094	464.2777	438.0172	411.2969	387.1090	372.7637	379.6378	394.5540	420.9995	450.4615	472.5925 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	6.4900	13.7804	0.6300	0.7000	0.7700	27.3325 (75)
South	7.2100	54.2217	0.6300	0.7000	0.7700	119.4759 (78)
Northwest	1.1700	13.7804	0.6300	0.7000	0.7700	4.9274 (81)

Solar gains	151.7358	228.1924	318.8705	420.5773	478.9048	512.8153	485.4137	440.3220	374.5099	273.0027	179.4419	130.3811 (83)
Total gains	636.4342	709.4018	783.1482	858.5945	890.2018	899.9243	858.1774	819.9598	769.0639	694.0022	629.9034	602.9735 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645	64.6645
alpha	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110	5.3110
util living area	0.9650	0.9391	0.8762	0.7437	0.5593	0.3624	0.2418	0.2607	0.4850	0.7726	0.9288	0.9718 (86)
Tweekday	19.4210	19.5785	19.7931	19.9621	20.0251	20.0356	20.0361	20.0361	20.0330	19.9642	19.6924	19.3711
Tweekend	20.5943	20.6887	20.8221	20.9373	20.9878	20.9990	20.9999	20.9999	20.9953	20.9355	20.7555	20.5647
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (88)
util rest of house												
	0.9554	0.9235	0.8477	0.6961	0.4976	0.2958	0.1712	0.1869	0.4097	0.7178	0.9079	0.9638 (89)
Tweekday	19.4210	19.5785	19.7931	19.9621	20.0251	20.0356	20.0361	20.0361	20.0330	19.9642	19.6924	19.3711
Tweekend	19.6877	19.7769	19.8985	19.9942	20.0299	20.0358	20.0361	20.0361	20.0344	19.9954	19.8415	19.6595
MIT 2	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361	20.0361 (90)
Living area fraction									fLA = Living area / (4) =			0.6543 (91)
MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (92)
Temperature adjustment												0.0000
adjusted MIT	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668	20.6668 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9620	0.9341	0.8670	0.7279	0.5383	0.3394	0.2174	0.2352	0.4593	0.7547	0.9222	0.9693 (94)
Useful gains	612.2352	662.6642	678.9901	624.9753	479.2193	305.4662	186.5702	192.8366	353.1995	523.7294	580.9134	584.4612 (95)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	979.1571	941.4169	834.4866	677.2361	488.5354	306.1248	186.6144	192.9044	356.4450	576.5957	796.7465	979.1571 (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	272.9899	187.3218	115.6894	37.6277	6.9312	0.0000	0.0000	0.0000	0.0000	39.3325	155.3998	293.6538 (98)
Space heating requirement												1108.9461 (98)
Space heating per m2											(98) / (4) =	18.6346 (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 %)												139.5310 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												794.7669 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	272.9899	187.3218	115.6894	37.6277	6.9312	0.0000	0.0000	0.0000	0.0000	39.3325	155.3998	293.6538 (98)
Space heating efficiency (main heating system 1)	139.5310	139.5310	139.5310	139.5310	139.5310	0.0000	0.0000	0.0000	0.0000	139.5310	139.5310	139.5310 (210)
Space heating fuel (main heating system)	195.6482	134.2511	82.9130	26.9673	4.9675	0.0000	0.0000	0.0000	0.0000	28.1891	111.3730	210.4577 (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 requirement	172.0274	151.6011	159.1570	142.5939	139.6795	124.7258	119.7068	131.4644	131.2663	147.8656	156.4531	167.8616 (64)
Efficiency of water heater (217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
Fuel for water heating, kWh/month	91.0415	80.2313	84.2301	75.4645	73.9221	66.0082	63.3520	69.5744	69.4696	78.2544	82.7991	88.8368 (219)
Water heating fuel used												923.1842 (219)
Annual totals kWh/year												
Space heating fuel - main system												794.7669 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
Mechanical ventilation fans (SFP = 0.2210)												41.5568 (230a)
Total electricity for the above, kWh/year												41.5568 (231)
Electricity for lighting (calculated in Appendix L)												270.3445 (232)
Total delivered energy for all uses												2029.8523 (238)

10a. Fuel costs - using BEDF prices (436)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	794.7669	16.9600	134.7925 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	923.1842	16.9600	156.5720 (247)
Mechanical ventilation fans	41.5568	16.9600	7.0480 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	270.3445	16.9600	45.8504 (250)
Additional standing charges			0.0000 (251)
Total energy cost			344.2630 (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	794.7669	0.5190	412.4840 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	923.1842	0.5190	479.1326 (264)
Space and water heating			891.6166 (265)
Pumps and fans	41.5568	0.5190	21.5680 (267)
Energy for lighting	270.3445	0.5190	140.3088 (268)
Total kg/year			1053.4934 (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	794.7669	3.0700	2439.9345 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	923.1842	3.0700	2834.1754 (264)
Space and water heating			5274.1098 (265)
Pumps and fans	41.5568	3.0700	127.5793 (267)
Energy for lighting	270.3445	3.0700	829.9576 (268)
Primary energy kWh/year			6231.6467 (272)
Primary energy kWh/m2/year			104.7160 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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 436 TEST (13 Dec 2018)
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	£344	£344	£0
Space heating	£142	£142	£0
Water heating	£157	£157	£0
Lighting	£46	£46	£0
Total cost of fuels	£344	£344	£0
Total cost of uses	£345	£345	£0
Delivered energy	34 kWh/m²	34 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	18 kg/m²	18 kg/m²	0 kg/m²
Primary energy	105 kWh/m²	105 kWh/m²	0 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	MidTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	246.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	305.18 (P1)
Transmission heat loss coefficient	37.47 (37)
Summer heat loss coefficient	342.65 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
North 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
North East	6.4900	98.8453	0.6300	0.7000	0.9000	229.1523
South	7.2100	112.2060	0.6300	0.7000	0.9000	288.9848
North West	1.1700	98.8453	0.6300	0.7000	0.9000	41.3110
total:						559.4480

	Jun	Jul	Aug	
Solar gains	592	559	506	(P3)
Internal gains	387	373	380	
Total summer gains	979	932	886	(P5)
Summer gain/loss ratio	2.86	2.72	2.59	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 246.1)	0.28	0.28	0.28	
Threshold temperature	19.13	20.90	20.66	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	21DES_BS_12				Issued on Date	10/05/2021
Assessment Reference	Be Green (ASHP + PV)	Prop Type Ref	Studio, Exp/Mid Flr			
Property	Plot '12', 86 Broad Street, Reading, Berkshire, RG1 2AP					
SAP Rating	87 B	DER	20.15	TER	29.15	
Environmental	88 B	% DER<TER	30.88			
CO ₂ Emissions (t/year)	0.79	DFEE	29.24	TFEE	38.75	
General Requirements Compliance	Pass	% DFEE<TFEE	24.54			
Assessor Details	Mr. Fulvio Vacca, Fulvio Vacca, Tel: 01924368145, softwaremanager@pellfrischmann.com				Assessor ID	W966-0001
Client						

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 49 m²

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

1a TER and DER

Fuel for main heating: Electricity
Fuel factor: 1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 29.15 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.15 kgCO₂/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 38.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 29.2 kWh/m²/yr OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified ψ -value of 0.080

3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

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

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.00 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, TRVs and bypass OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North East: 6.49 m², No overhang
Windows facing North West: 1.17 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Air permeability 3.0 m³/m²h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1163 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			7.6600	1.3258	10.1553		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096	110.0000	1289.2000 (29a)
Total net area of external elements Aum(A, m ²)			23.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	15.4819			(33)
Party Wall with Flats			52.5500	0.0000	0.0000	20.0000	1051.0000 (32)
Floor Above Retail			47.5200			80.0000	3801.6000 (32d)
Party Ceiling			49.1800			80.0000	3934.4000 (32b)
Internal Walls			71.6000			9.0000	644.4000 (32c)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (User defined value 0.080 * total exposed area)
Total fabric heat loss

(28)...(30) + (32) + (32a)...(32e) = 10853.4000 (34)												
												220.6873 (35)
												1.8528 (36)
												17.3347 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 21.0171	Feb 21.0171	Mar 21.0171	Apr 21.0171	May 21.0171	Jun 21.0171	Jul 21.0171	Aug 21.0171	Sep 21.0171	Oct 21.0171	Nov 21.0171	Dec 21.0171 (38)
Heat transfer coeff	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518 (39)
Average = Sum(39)m / 12 =												38.3518 (39)
HLP	Jan 0.7798	Feb 0.7798	Mar 0.7798	Apr 0.7798	May 0.7798	Jun 0.7798	Jul 0.7798	Aug 0.7798	Sep 0.7798	Oct 0.7798	Nov 0.7798	Dec 0.7798 (40)
HLP (average)												0.7798 (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												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
Daily hot water use	Jan 81.1439	Feb 78.1932	Mar 75.2425	Apr 72.2918	May 69.3411	Jun 66.3905	Jul 66.3905	Aug 69.3411	Sep 72.2918	Oct 75.2425	Nov 78.1932	Dec 81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)												Total = Sum(45)m = 1160.6449 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	18.0501	15.7867	16.2905	14.2025	13.6276	11.7596	10.8970	12.5044	12.6538	14.7468	16.0972	17.4806 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395	(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	(63)
Output from w/h	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
Heat gains from water heating, kWh/month	72.0130	63.8989	68.1125	62.4517	62.2097	57.0367	56.1569	59.7201	59.0188	64.6906	66.6518	70.7505 (65)
Total per year (kWh/year) = Sum(64)m =												1631.6409 (64)

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	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5689	12.0518	9.8012	7.4201	5.5466	4.6827	5.0598	6.5769	8.8276	11.2086	13.0821	13.9460 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.1044	146.6101	142.8157	134.7379	124.5411	114.9576	108.5552	107.0495	110.8439	118.9217	129.1184	138.7020 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299 (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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394 (71)
Water heating gains (Table 5)	96.7917	95.0876	91.5491	86.7385	83.6153	79.2176	75.4797	80.2689	81.9706	86.9497	92.5720	95.0948 (72)
Total internal gains	303.4547	301.7393	292.1558	276.8863	261.6928	246.8477	237.0845	241.8851	249.6318	265.0698	282.7623	295.7326 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	FF	Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast				6.4900	11.2829		0.6300		0.7000	0.7700	22.3789	
Northwest				1.1700	11.2829		0.6300		0.7000	0.7700	4.0344 (75)	
Solar gains	26.4133	53.7651	96.8676	159.0843	213.8406	227.9767	213.2675	170.0193	118.0346	65.7052	33.2348	21.5704 (83)
Total gains	329.8680	355.5044	389.0233	435.9706	475.5334	474.8243	450.3520	411.9045	367.6664	330.7749	315.9971	317.3030 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100
alpha	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407
util living area	0.9922	0.9862	0.9651	0.8873	0.7145	0.5128	0.3742	0.4271	0.6912	0.9285	0.9841	0.9939 (86)
Tweekday	19.5289	19.6476	19.8655	20.1144	20.2426	20.2685	20.2707	20.2704	20.2563	20.0861	19.7630	19.4884
Tweekend	20.5397	20.6078	20.7344	20.8865	20.9751	20.9971	20.9997	20.9993	20.9846	20.8652	20.6735	20.5165
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (88)
util rest of house	0.9902	0.9826	0.9561	0.8620	0.6684	0.4561	0.3125	0.3600	0.6284	0.9060	0.9793	0.9922 (89)
Tweekday	19.5289	19.6476	19.8655	20.1144	20.2426	20.2685	20.2707	20.2704	20.2563	20.0861	19.7630	19.4884
Tweekend	19.8507	19.9178	20.0413	20.1822	20.2549	20.2695	20.2708	20.2706	20.2626	20.1662	19.9832	19.8277
MIT 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (90)
Living area fraction									fLA = Living area / (4) =			0.7544 (91)
MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (92)
Temperature adjustment												0.0000
adjusted MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (93)

8. Space heating requirement

Utilisation	0.9918	0.9854	0.9631	0.8815	0.7035	0.4990	0.3591	0.4107	0.6763	0.9235	0.9830	0.9935 (94)
Useful gains	327.1529	350.3219	374.6524	384.3071	334.5413	236.9527	161.7041	169.1569	248.6647	305.4726	310.6276	315.2402 (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	633.6059	610.5948	549.2320	457.1877	349.8027	238.5826	161.8790	169.5494	257.7585	391.9897	526.2209	637.4411 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fraction	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	228.0010	174.9034	129.8872	52.4740	11.3545	0.0000	0.0000	0.0000	0.0000	64.3687	155.2272	239.7174 (98)
Space heating												1055.9335 (98)
Space heating per m2										(98) / (4) =		21.4708 (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 %)												146.6826 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												719.8766 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	228.0010	174.9034	129.8872	52.4740	11.3545	0.0000	0.0000	0.0000	0.0000	64.3687	155.2272	239.7174 (98)
Space heating efficiency (main heating system 1)	146.6826	146.6826	146.6826	146.6826	146.6826	0.0000	0.0000	0.0000	0.0000	146.6826	146.6826	146.6826 (210)
Space heating fuel (main heating system)	155.4384	119.2394	88.5499	35.7739	7.7409	0.0000	0.0000	0.0000	0.0000	43.8830	105.8253	163.4260 (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	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
Efficiency of water heater	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250 (216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250 (217)
Fuel for water heating, kWh/month	90.0134	79.3691	83.4278	74.8884	73.4613	65.7455	63.2415	69.2577	69.0922	77.6500	81.9800	87.8818 (219)
Water heating fuel used												916.0089 (219)
Annual totals kWh/year												
Space heating fuel - main system												719.8766 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												34.3432 (230a)
Total electricity for the above, kWh/year												34.3432 (231)
Electricity for lighting (calculated in Appendix L)												239.6312 (232)
Total delivered energy for all uses												1909.8599 (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	719.8766	0.5190	373.6160 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	916.0089	0.5190	475.4086 (264)
Space and water heating			849.0246 (265)
Pumps and fans	34.3432	0.5190	17.8241 (267)
Energy for lighting	239.6312	0.5190	124.3686 (268)
Total CO2, kg/year			991.2173 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.1500 (273)

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

DER			20.1500 ZC1
Total Floor Area		TFA	49.1800
Assumed number of occupants		N	1.6660
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.4839 ZC2
CO2 emissions from cooking, equation (L16)			3.2327 ZC3
Total CO2 emissions			40.8666 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			40.8666 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					20.0000 / (5) = 0.1570 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4070 (18)
Number of sides sheltered					3 (19)
Shelter factor					(20) = 1 - [0.075 x (19)] = 0.7750 (20)
Infiltration rate adjusted to include shelter factor					(21) = (18) x (20) = 0.3154 (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												
	0.4022	0.3943	0.3864	0.3470	0.3391	0.2997	0.2997	0.2918	0.3154	0.3391	0.3549	0.3706 (22b)
Effective ac	0.5809	0.5777	0.5747	0.5602	0.5575	0.5449	0.5449	0.5426	0.5498	0.5575	0.5630	0.5687 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200			(26)				
TER Opening Type (Uw = 1.40)			7.6600	1.3258	10.1553			(27)				
Floor Above Street			1.6600	0.1300	0.2158			(28b)				
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096			(29a)				
Total net area of external elements Aum(A, m2)			23.1600					(31)				
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 14.6007			(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								5.0284 (36)				
Total fabric heat loss								(33) + (36) = 19.6291 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	24.4166	24.2846	24.1552	23.5474	23.4337	22.9044	22.9044	22.8064	23.1083	23.4337	23.6638	23.9042 (38)
	44.0457	43.9137	43.7843	43.1765	43.0628	42.5335	42.5335	42.4355	42.7374	43.0628	43.2929	43.5333 (39)
Average = Sum(39)m / 12 =												43.1760 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8956	0.8929	0.8903	0.8779	0.8756	0.8649	0.8649	0.8629	0.8690	0.8756	0.8803	0.8852 (40)
Days in month												0.8779 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												
Average daily hot water use (litres/day)												1.6660 (42)
												73.7672 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	81.1439	78.1932	75.2425	72.2918	69.3411	66.3905	66.3905	69.3411	72.2918	75.2425	78.1932	81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)												Total = Sum(45)m = 1160.6449 (45)
Distribution loss (46)m = 0.15 x (45)m												
	18.0501	15.7867	16.2905	14.2025	13.6276	11.7596	10.8970	12.5044	12.6538	14.7468	16.0972	17.4806 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8102 (55)
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (56)
Primary loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (57)
Total heat required for water heating calculated for each month	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)
Solar input	168.7117	148.9409	156.9810	141.5001	139.2283	125.2143	121.0242	131.7406	131.1757	146.6894	154.1321	164.9148 (62)
Output from w/h	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)
Heat gains from water heating, kWh/month	168.7117	148.9409	156.9810	141.5001	139.2283	125.2143	121.0242	131.7406	131.1757	146.6894	154.1321	164.9148 (64)
	78.7132	69.9507	74.8128	68.9358	68.9100	63.5208	62.8571	66.4203	65.5029	71.3908	73.1359	77.4507 (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	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5689	12.0518	9.8012	7.4201	5.5466	4.6827	5.0598	6.5769	8.8276	11.2086	13.0821	13.9460	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.1044	146.6101	142.8157	134.7379	124.5411	114.9576	108.5552	107.0495	110.8439	118.9217	129.1184	138.7020	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	(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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	(71)
Water heating gains (Table 5)	105.7974	104.0933	100.5548	95.7442	92.6210	88.2233	84.4854	89.2746	90.9763	95.9554	101.5777	104.1005	(72)
Total internal gains	315.4604	313.7450	304.1615	288.8920	273.6985	258.8534	249.0902	253.8908	261.6375	277.0755	294.7680	307.7383	(73)

6. Solar gains

[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
Northeast				6.4900	11.2829	0.6300	0.7000			0.7700			22.3789 (75)
Northwest				1.1700	11.2829	0.6300	0.7000			0.7700			4.0344 (81)
Solar gains	26.4133	53.7651	96.8676	159.0843	213.8406	227.9767	213.2675	170.0193	118.0346	65.7052	33.2348	21.5704	(83)
Total gains	341.8737	367.5101	401.0290	447.9763	487.5391	486.8300	462.3577	423.9102	379.6721	342.7806	328.0028	329.3087	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.5394	77.7725	78.0024	79.1003	79.3092	80.2962	80.2962	80.4817	79.9131	79.3092	78.8878	78.4520	
alpha	6.1693	6.1848	6.2002	6.2734	6.2873	6.3531	6.3531	6.3654	6.3275	6.2873	6.2592	6.2301	
util living area	0.9952	0.9915	0.9778	0.9193	0.7655	0.5529	0.4040	0.4587	0.7351	0.9491	0.9897	0.9962	(86)
MIT	20.2084	20.3136	20.5135	20.7778	20.9452	20.9939	20.9993	20.9985	20.9682	20.7537	20.4434	20.1908	(87)
Th 2	20.5522	20.5535	20.5549	20.5610	20.5622	20.5676	20.5676	20.5686	20.5655	20.5622	20.5599	20.5574	(88)
util rest of house	0.9945	0.9902	0.9743	0.9074	0.7390	0.5174	0.3646	0.4164	0.6984	0.9391	0.9878	0.9956	(89)
MIT 2	19.7996	19.9054	20.1046	20.3662	20.5193	20.5636	20.5672	20.5678	20.5430	20.3469	20.0403	19.7865	(90)
Living area fraction	20.1080	20.2133	20.4130	20.6767	20.8406	20.8882	20.8932	20.8927	20.8638	20.6538	20.3444	20.0915	(92)
Temperature adjustment	20.7080	20.8133	21.0130	21.2767	21.4406	21.4882	21.4932	21.4927	21.4638	21.2538	20.9444	20.6915	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9948	0.9910	0.9779	0.9260	0.7903	0.5921	0.4486	0.5063	0.7710	0.9541	0.9895	0.9958	(94)
Ext temp.	340.0870	364.2040	392.1829	414.8294	385.2858	288.2338	207.4027	214.6461	292.7280	327.0316	324.5474	327.9161	(95)
Heat loss rate W	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)
Month fracti	722.7015	698.8133	635.4426	534.3819	419.4565	292.9798	208.1229	216.1102	314.7091	458.7818	599.3630	717.9292	(97)
Space heating kWh	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 per m ²	284.6652	224.8574	180.9853	86.0779	25.4230	0.0000	0.0000	0.0000	0.0000	98.0222	197.8672	290.1698	(98)
												1388.0679	(98)
												28.2242	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													88.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1568.4384 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	284.6652	224.8574	180.9853	86.0779	25.4230	0.0000	0.0000	0.0000	0.0000	98.0222	197.8672	290.1698	(98)
Space heating efficiency (main heating system 1)	88.5000	88.5000	88.5000	88.5000	88.5000	0.0000	0.0000	0.0000	0.0000	88.5000	88.5000	88.5000	(210)
Space heating fuel (main heating system)	321.6556	254.0762	204.5031	97.2631	28.7266	0.0000	0.0000	0.0000	0.0000	110.7596	223.5788	327.8754	(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 requirement	168.7117	148.9409	156.9810	141.5001	139.2283	125.2143	121.0242	131.7406	131.1757	146.6894	154.1321	164.9148	(64)
Efficiency of water heater (217)m	81.1787	80.8895	80.1730	78.5166	76.2739	74.8000	74.8000	74.8000	74.8000	78.7475	80.4602	81.2863	(216)
Fuel for water heating, kWh/month	207.8275	184.1289	195.8029	180.2170	182.5374	167.3988	161.7971	176.1238	175.3685	186.2782	191.5632	202.8815	(219)
Water heating fuel used												2211.9248	(219)
Annual totals kWh/year													
Space heating fuel - main system												1568.4384	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												39.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												84.0000	(231)
Electricity for lighting (calculated in Appendix L)												239.6312	(232)
Total delivered energy for all uses												4103.9944	(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	1568.4384	0.2160	338.7827 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2211.9248	0.2160	477.7758 (264)
Space and water heating			816.5584 (265)
Pumps and fans	84.0000	0.5190	43.5960 (267)
Energy for lighting	239.6312	0.5190	124.3686 (268)
Total CO2, kg/m2/year			984.5230 (272)
Emissions per m2 for space and water heating			16.6035 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.5288 (272b)
Emissions per m2 for pumps and fans			0.8865 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.6035 * 1.55) + 2.5288 + 0.8865, rounded to 2 d.p.			29.1500 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour 20.0000 / (5) = 0.1570 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.3070 (18)
Number of sides sheltered					3 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.7750 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2379 (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												
Effective ac	0.3034	0.2974	0.2915	0.2617	0.2558	0.2260	0.2260	0.2201	0.2379	0.2558	0.2677	0.2796 (22b)
	0.5460	0.5442	0.5425	0.5343	0.5327	0.5255	0.5255	0.5242	0.5283	0.5327	0.5358	0.5391 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			7.6600	1.3258	10.1553		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096	110.0000	1289.2000 (29a)
Total net area of external elements Aum(A, m ²)			23.1600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	15.4819		(33)
Party Wall with Flats			52.5500	0.0000	0.0000	20.0000	1051.0000 (32)
Floor Above Retail			47.5200			80.0000	3801.6000 (32d)
Party Ceiling			49.1800			100.0000	4918.0000 (32b)
Internal Walls			71.6000			9.0000	644.4000 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	11837.0000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							240.6873 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							1.8528 (36)
Total fabric heat loss						(33) + (36) =	17.3347 (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	22.9513	22.8762	22.8026	22.4568	22.3921	22.0909	22.0909	22.0351	22.2069	22.3921	22.5230	22.6598 (38)
Heat transfer coeff	40.2860	40.2109	40.1373	39.7915	39.7268	39.4256	39.4256	39.3698	39.5416	39.7268	39.8577	39.9945 (39)
Average = Sum(39)m / 12 =												39.7912 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.8192	0.8176	0.8161	0.8091	0.8078	0.8017	0.8017	0.8005	0.8040	0.8078	0.8104	0.8132 (40)
HLP (average)												0.8091 (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												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	81.1439	78.1932	75.2425	72.2918	69.3411	66.3905	66.3905	69.3411	72.2918	75.2425	78.1932	81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)										Total = Sum(45)m =		1160.6449 (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:												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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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	25.5710	22.3645	23.0782	20.1201	19.3058	16.6594	15.4374	17.7146	17.9262	20.8912	22.8044	24.7641 (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	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5689	12.0518	9.8012	7.4201	5.5466	4.6827	5.0598	6.5769	8.8276	11.2086	13.0821	13.9460	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.1044	146.6101	142.8157	134.7379	124.5411	114.9576	108.5552	107.0495	110.8439	118.9217	129.1184	138.7020	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	(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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	(71)
Water heating gains (Table 5)	34.3696	33.2806	31.0191	27.9446	25.9486	23.1381	20.7492	23.8100	24.8975	28.0796	31.6728	33.2851	(72)
Total internal gains	241.0327	239.9323	231.6258	218.0925	204.0261	190.7681	182.3540	185.4262	192.5587	206.1997	221.8632	233.9229	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				6.4900	11.2829	0.6300	0.7000	0.7700	22.3789 (75)			
Northwest				1.1700	11.2829	0.6300	0.7000	0.7700	4.0344 (81)			
Solar gains	26.4133	53.7651	96.8676	159.0843	213.8406	227.9767	213.2675	170.0193	118.0346	65.7052	33.2348	21.5704 (83)
Total gains	267.4460	293.6973	328.4933	377.1768	417.8667	418.7448	395.6215	355.4455	310.5933	271.9049	255.0979	255.4934 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	81.6177	81.7702	81.9202	82.6321	82.7667	83.3989	83.3989	83.5171	83.1543	82.7667	82.4949	82.2126	
alpha	6.4412	6.4513	6.4613	6.5088	6.5178	6.5599	6.5599	6.5678	6.5436	6.5178	6.4997	6.4808	
util living area	0.9984	0.9967	0.9890	0.9474	0.8081	0.5937	0.4374	0.5065	0.8051	0.9766	0.9965	0.9988 (86)	
MIT	20.1488	20.2557	20.4603	20.7390	20.9332	20.9922	20.9991	20.9978	20.9521	20.6896	20.3699	20.1248 (87)	
Th 2	20.2368	20.2381	20.2394	20.2455	20.2466	20.2519	20.2519	20.2529	20.2499	20.2466	20.2443	20.2419 (88)	
util rest of house	0.9979	0.9956	0.9855	0.9311	0.7627	0.5281	0.3636	0.4258	0.7422	0.9664	0.9952	0.9985 (89)	
MIT 2	19.4498	19.5574	19.7613	20.0347	20.2028	20.2484	20.2516	20.2522	20.2233	19.9933	19.6768	19.4301 (90)	
Living area fraction									fLA = Living area / (4) =			0.7544 (91)	
MIT	19.9771	20.0842	20.2886	20.5660	20.7538	20.8095	20.8155	20.8146	20.7731	20.5186	20.1997	19.9541 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.9771	20.0842	20.2886	20.5660	20.7538	20.8095	20.8155	20.8146	20.7731	20.5186	20.1997	19.9541 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9977	0.9954	0.9857	0.9385	0.7940	0.5773	0.4193	0.4867	0.7874	0.9706	0.9951	0.9983 (94)
Useful gains	266.8364	292.3345	323.8083	353.9927	331.8013	241.7544	165.8718	172.9908	244.5640	263.9040	253.8515	255.0554 (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	631.5682	610.5707	553.4383	464.2083	359.6780	244.8138	166.1982	173.8031	263.8641	394.0344	522.1234	630.0794 (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	271.3605	213.8548	170.8447	79.3552	20.7403	0.0000	0.0000	0.0000	0.0000	96.8170	193.1558	279.0179 (98)
Space heating												1325.1461 (98)
Space heating per m2										(98) / (4) =		26.9448 (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	370.6009	291.7496	299.2109	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9749	0.9904	0.9824	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	361.2884	288.9603	293.9388	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	552.8712	524.6767	478.7332	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												

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Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	137.9396	175.3731	137.4870	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												450.7997 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	34.4849	43.8433	34.3717	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												112.6999 (107)
Energy for space heating												2.2916 (108)
Energy for space cooling												26.9448 (99)
Total												2.2916 (108)
Dwelling Fabric Energy Efficiency (DFEE)												29.2364 (109)
												29.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					20.0000 / (5) = 0.1570 (8)
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.4070 (18)
					3 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3154 (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												
	0.4022	0.3943	0.3864	0.3470	0.3391	0.2997	0.2997	0.2918	0.3154	0.3391	0.3549	0.3706 (22b)
Effective ac	0.5809	0.5777	0.5747	0.5602	0.5575	0.5449	0.5449	0.5426	0.5498	0.5575	0.5630	0.5687 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200			(26)				
TER Opening Type (Uw = 1.40)			7.6600	1.3258	10.1553			(27)				
Floor Above Street			1.6600	0.1300	0.2158			(28b)				
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096			(29a)				
Total net area of external elements Aum(A, m2)			23.1600					(31)				
Fabric heat loss, W/K = Sum (A x U)					(26) ... (30) + (32) =	14.6007		(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								5.0284 (36)				
Total fabric heat loss						(33) + (36) =		19.6291 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	24.4166	24.2846	24.1552	23.5474	23.4337	22.9044	22.9044	22.8064	23.1083	23.4337	23.6638	23.9042 (38)
Average = Sum(39)m / 12 =	44.0457	43.9137	43.7843	43.1765	43.0628	42.5335	42.5335	42.4355	42.7374	43.0628	43.2929	43.5333 (39)
												43.1760 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8956	0.8929	0.8903	0.8779	0.8756	0.8649	0.8649	0.8629	0.8690	0.8756	0.8803	0.8852 (40)
Days in month												0.8779 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	81.1439	78.1932	75.2425	72.2918	69.3411	66.3905	66.3905	69.3411	72.2918	75.2425	78.1932	81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)	Total = Sum(45)m =											1160.6449 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month
25.5710 22.3645 23.0782 20.1201 19.3058 16.6594 15.4374 17.7146 17.9262 20.8912 22.8044 24.7641 (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	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	83.2993	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5689	12.0518	9.8012	7.4201	5.5466	4.6827	5.0598	6.5769	8.8276	11.2086	13.0821	13.9460	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.1044	146.6101	142.8157	134.7379	124.5411	114.9576	108.5552	107.0495	110.8439	118.9217	129.1184	138.7020	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	31.3299	(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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	(71)
Water heating gains (Table 5)	34.3696	33.2806	31.0191	27.9446	25.9486	23.1381	20.7492	23.8100	24.8975	28.0796	31.6728	33.2851	(72)
Total internal gains	241.0327	239.9323	231.6258	218.0925	204.0261	190.7681	182.3540	185.4262	192.5587	206.1997	221.8632	233.9229	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				6.4900	11.2829	0.6300		0.7000		0.7700		22.3789 (75)
Northwest				1.1700	11.2829	0.6300		0.7000		0.7700		4.0344 (81)
Solar gains	26.4133	53.7651	96.8676	159.0843	213.8406	227.9767	213.2675	170.0193	118.0346	65.7052	33.2348	21.5704 (83)
Total gains	267.4460	293.6973	328.4933	377.1768	417.8667	418.7448	395.6215	355.4455	310.5933	271.9049	255.0979	255.4934 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.5394	77.7725	78.0024	79.1003	79.3092	80.2962	80.2962	80.4817	79.9131	79.3092	78.8878	78.4520	
alpha	6.1693	6.1848	6.2002	6.2734	6.2873	6.3531	6.3531	6.3654	6.3275	6.2873	6.2592	6.2301	
util living area	0.9988	0.9974	0.9918	0.9603	0.8438	0.6347	0.4709	0.5437	0.8401	0.9825	0.9973	0.9991	(86)
MIT	20.0620	20.1704	20.3805	20.6780	20.9037	20.9870	20.9983	20.9960	20.9317	20.6368	20.3024	20.0447	(87)
Th 2	20.1712	20.1735	20.1758	20.1863	20.1883	20.1975	20.1975	20.1992	20.1939	20.1883	20.1843	20.1801	(88)
util rest of house	0.9984	0.9966	0.9889	0.9464	0.7989	0.5617	0.3862	0.4520	0.7772	0.9741	0.9963	0.9988	(89)
MIT 2	19.3061	19.4162	19.6267	19.9244	20.1246	20.1917	20.1970	20.1980	20.1556	19.8907	19.5571	19.2963	(90)
Living area fraction									fLA = Living area / (4) =			0.7544	(91)
MIT	19.8763	19.9852	20.1953	20.4929	20.7123	20.7917	20.8015	20.8000	20.7410	20.4535	20.1193	19.8609	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8763	19.9852	20.1953	20.4929	20.7123	20.7917	20.8015	20.8000	20.7410	20.4535	20.1193	19.8609	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9964	0.9890	0.9521	0.8289	0.6162	0.4501	0.5211	0.8217	0.9772	0.9962	0.9986	(94)
Useful gains	266.9572	292.6259	324.8869	359.1194	346.3779	258.0435	178.0728	185.2323	255.2114	265.7124	254.1176	255.1401	(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	686.0690	662.4456	599.6405	500.5421	388.0969	263.3526	178.7033	186.7172	283.8211	424.3196	563.6440	681.7715	(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	311.8192	248.5188	204.4167	101.8243	31.0389	0.0000	0.0000	0.0000	0.0000	118.0038	222.8590	317.4138	(98)
Space heating												1555.8945	(98)
Space heating per m2												31.6367	(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	399.8148	314.7478	322.5095	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9611	0.9841	0.9721	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	384.2614	309.7306	313.5034	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	552.8712	524.6767	478.7332	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	121.3990	159.9200	122.9310	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												404.2500	(104)
Cooled fraction												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)

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Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	30.3498	39.9800	30.7327	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													101.0625 (107)
Space cooling per m2													2.0550 (108)
Energy for space heating													31.6367 (99)
Energy for space cooling													2.0550 (108)
Total													33.6917 (109)
Target Fabric Energy Efficiency (TFEE)													38.7 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1163 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			7.6600	1.3258	10.1553		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096	110.0000	1289.2000 (29a)
Total net area of external elements Aum(A, m2)			23.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		15.4819		(33)
Party Wall with Flats			52.5500	0.0000	0.0000	20.0000	1051.0000 (32)
Floor Above Retail			47.5200			80.0000	3801.6000 (32d)
Party Ceiling			49.1800			80.0000	3934.4000 (32b)
Internal Walls			71.6000			9.0000	644.4000 (32c)

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	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171 (38)
Heat transfer coeff	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518 (39)
Average = Sum(39)m / 12 =												38.3518 (39)
HLP	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798 (40)
HLP (average)												0.7798 (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												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
Daily hot water use	81.1439	78.1932	75.2425	72.2918	69.3411	66.3905	66.3905	69.3411	72.2918	75.2425	78.1932	81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)												Total = Sum(45)m = 1160.6449 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	18.0501	15.7867	16.2905	14.2025	13.6276	11.7596	10.8970	12.5044	12.6538	14.7468	16.0972	17.4806 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (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)
Output from w/h	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
RHI water heating demand												1632 (64)
Heat gains from water heating, kWh/month	72.0130	63.8989	68.1125	62.4517	62.2097	57.0367	56.1569	59.7201	59.0188	64.6906	66.6518	70.7505 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9223	30.1295	24.5029	18.5503	13.8666	11.7067	12.6495	16.4424	22.0689	28.0215	32.7053	34.8651 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.5737	218.8210	213.1578	201.1013	185.8823	171.5785	162.0227	159.7753	165.4386	177.4950	192.7141	207.0179 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619 (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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394 (71)
Water heating gains (Table 5)	96.7917	95.0876	91.5491	86.7385	83.6153	79.2176	75.4797	80.2689	81.9706	86.9497	92.5720	95.0948 (72)
Total internal gains	427.2692	424.0198	409.1914	386.3717	363.3457	342.4844	330.1335	336.4683	349.4597	372.4479	397.9730	416.9594 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
Northeast				6.4900	13.7804	0.6300	0.7000	0.7700		27.3325 (75)		
Northwest				1.1700	13.7804	0.6300	0.7000	0.7700		4.9274 (81)		
Solar gains	32.2599	57.6965	103.6029	172.5657	225.1931	253.3868	234.9395	192.7002	134.5994	75.8319	40.0577	26.4478 (83)
Total gains	459.5291	481.7163	512.7944	558.9374	588.5388	595.8712	565.0731	529.1685	484.0591	448.2798	438.0307	443.4072 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100
Feb	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407
Mar	0.9516	0.9313	0.8691	0.7231	0.5232	0.3344	0.2240	0.2464	0.4730	0.7591	0.9110	0.9585 (86)
Apr	19.8833	19.9671	20.1143	20.2319	20.2669	20.2707	20.2708	20.2708	20.2695	20.2294	20.0622	19.8532
May	20.7464	20.7969	20.8884	20.9683	20.9960	20.9998	21.0000	21.0000	20.9983	20.9646	20.8537	20.7284
Jun	24 / 16	9	8	8	9	9	9	9	8	9	8	9
Jul	24 / 9	22	20	22	22	21	22	22	22	22	22	22
Aug	16 / 9	0	0	0	0	0	0	0	0	0	0	0
Sep	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Oct	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (88)
Nov	0.9411	0.9171	0.8449	0.6848	0.4777	0.2877	0.1745	0.1936	0.4166	0.7147	0.8908	0.9492 (89)
Dec	19.8833	19.9671	20.1143	20.2319	20.2669	20.2707	20.2708	20.2708	20.2695	20.2294	20.0622	19.8532
Living area fraction	20.0513	20.0988	20.1822	20.2488	20.2686	20.2708	20.2709	20.2708	20.2701	20.2474	20.1527	20.0343
MIT	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (90)
Temperature adjustment	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (91)
adjusted MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (92)
Heat loss rate W												0.0000 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9492	0.9280	0.8635	0.7139	0.5121	0.3230	0.2118	0.2334	0.4592	0.7486	0.9064	0.9564 (94)
Ext temp.	436.1959	447.0387	442.7965	399.0467	301.3902	192.4473	119.6862	123.5165	222.2776	335.5915	397.0361	424.0817 (95)
Heat loss rate W	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	602.9245	579.9134	514.7154	418.8359	303.7806	192.5605	119.6921	123.5273	223.2419	357.4731	491.7043	602.9245	(97)
Space heating kWh	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	124.0460	89.2918	53.5076	14.2482	1.7785	0.0000	0.0000	0.0000	0.0000	16.2799	68.1611	133.0590	(98)
RHI space heating demand												500.3722	(98)
												500	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1163 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			7.6600	1.3258	10.1553		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096	110.0000	1289.2000 (29a)
Total net area of external elements Aum(A, m ²)			23.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	15.4819			(33)
Party Wall with Flats			52.5500	0.0000	0.0000	20.0000	1051.0000 (32)
Floor Above Retail			47.5200			80.0000	3801.6000 (32d)
Party Ceiling			49.1800			80.0000	3934.4000 (32b)
Internal Walls			71.6000			9.0000	644.4000 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	10853.4000 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K				220.6873 (35)			
Thermal bridges (User defined value 0.080 * total exposed area)				1.8528 (36)			
Total fabric heat loss			(33) + (36) =	17.3347 (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	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171	21.0171 (38)
Heat transfer coeff	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518 (39)
Average = Sum(39)m / 12 =												38.3518 (39)
HLP	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798	0.7798 (40)
HLP (average)												0.7798 (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												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
Daily hot water use	81.1439	78.1932	75.2425	72.2918	69.3411	66.3905	66.3905	69.3411	72.2918	75.2425	78.1932	81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)												Total = Sum(45)m = 1160.6449 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	18.0501	15.7867	16.2905	14.2025	13.6276	11.7596	10.8970	12.5044	12.6538	14.7468	16.0972	17.4806 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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												
160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (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)
Output from w/h								Solar input (sum of months) =	Sum (63)m =			
160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)	
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum (64)m =	1631.6409	(64)	
72.0130	63.8989	68.1125	62.4517	62.2097	57.0367	56.1569	59.7201	59.0188	64.6906	66.6518	70.7505 (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	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9223	30.1295	24.5029	18.5503	13.8666	11.7067	12.6495	16.4424	22.0689	28.0215	32.7053	34.8651 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.5737	218.8210	213.1578	201.1013	185.8823	171.5785	162.0227	159.7753	165.4386	177.4950	192.7141	207.0179 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619 (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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394 (71)
Water heating gains (Table 5)	96.7917	95.0876	91.5491	86.7385	83.6153	79.2176	75.4797	80.2689	81.9706	86.9497	92.5720	95.0948 (72)
Total internal gains	427.2692	424.0198	409.1914	386.3717	363.3457	342.4844	330.1335	336.4683	349.4597	372.4479	397.9730	416.9594 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				6.4900	11.2829	0.6300		0.7000		0.7700		22.3789
Northwest				1.1700	11.2829	0.6300		0.7000		0.7700		(75) 4.0344
Solar gains	26.4133	53.7651	96.8676	159.0843	213.8406	227.9767	213.2675	170.0193	118.0346	65.7052	33.2348	21.5704
Total gains	453.6826	477.7848	506.0590	545.4561	577.1863	570.4611	543.4011	506.4876	467.4943	438.1530	431.2077	(83) 438.5298

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100
alpha	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407
util living area	0.9630	0.9459	0.8990	0.7836	0.6059	0.4290	0.3104	0.3480	0.5589	0.8183	0.9352	0.9692 (86)
Tweekday	19.8057	19.8999	20.0554	20.2008	20.2597	20.2700	20.2708	20.2707	20.2665	20.1963	19.9896	19.7665
Tweekend	20.7008	20.7567	20.8513	20.9462	20.9898	20.9989	20.9999	20.9998	20.9951	20.9407	20.8092	20.6777
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (88)
util rest of house	0.9550	0.9347	0.8796	0.7500	0.5621	0.3807	0.2590	0.2930	0.5026	0.7810	0.9201	0.9623 (89)
Tweekday	19.8057	19.8999	20.0554	20.2008	20.2597	20.2700	20.2708	20.2707	20.2665	20.1963	19.9896	19.7665
Tweekend	20.0074	20.0608	20.1488	20.2312	20.2645	20.2704	20.2708	20.2708	20.2684	20.2286	20.1115	19.9852
MIT 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (90)
Living area fraction									fLA = Living area / (4) =			0.7544 (91)
MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (92)
Temperature adjustment												0.0000
adjusted MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9612	0.9433	0.8945	0.7757	0.5953	0.4172	0.2978	0.3345	0.5453	0.8096	0.9318	0.9676 (94)
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	633.6059	610.5948	549.2320	457.1877	349.8027	238.5826	161.8790	169.5494	257.7585	391.9897	526.2209	637.4411 (97)

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	146.9482	107.4406	71.8247	24.5369	4.6265	0.0000	0.0000	0.0000	0.0000	27.7157	89.5989	158.5584 (98)
Space heating												631.2498 (98)
Space heating per m2										(98) / (4) =		12.8355 (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 %)												146.6826 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												430.3510 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	146.9482	107.4406	71.8247	24.5369	4.6265	0.0000	0.0000	0.0000	0.0000	27.7157	89.5989	158.5584 (98)
Space heating efficiency (main heating system 1)	146.6826	146.6826	146.6826	146.6826	146.6826	0.0000	0.0000	0.0000	0.0000	146.6826	146.6826	146.6826 (210)
Space heating fuel (main heating system)	100.1811	73.2470	48.9661	16.7279	3.1541	0.0000	0.0000	0.0000	0.0000	18.8950	61.0835	108.0963 (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	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
Efficiency of water heater	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250 (216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250 (217)
Fuel for water heating, kWh/month	90.0134	79.3691	83.4278	74.8884	73.4613	65.7455	63.2415	69.2577	69.0922	77.6500	81.9800	87.8818 (219)
Water heating fuel used												916.0089 (219)
Annual totals kWh/year												
Space heating fuel - main system												430.3510 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												34.3432 (230a)
Total electricity for the above, kWh/year												34.3432 (231)
Electricity for lighting (calculated in Appendix L)												239.6312 (232)
Total delivered energy for all uses												1620.3343 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	430.3510	13.1900	56.7633 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	916.0089	13.1900	120.8216 (247)
Mechanical ventilation fans	34.3432	13.1900	4.5299 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	239.6312	13.1900	31.6074 (250)
Additional standing charges			0.0000 (251)
Total energy cost			213.7221 (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] =	0.9531 (257)
SAP value		86.7042
SAP rating (Section 12)		87 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	430.3510	0.5190	223.3522 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	916.0089	0.5190	475.4086 (264)
Space and water heating			698.7608 (265)
Pumps and fans	34.3432	0.5190	17.8241 (267)
Energy for lighting	239.6312	0.5190	124.3686 (268)
Total kg/year			840.9535 (272)
CO2 emissions per m2			17.1000 (273)
EI value			88.0349
EI rating			88 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.00) / 1.4668 = 8.992$, stars = 2
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 1.4668 = 0.3538$, stars = 3
Water heating energy efficiency	$13.19 / 1.7813 = 7.405$, stars = 3
Water heating environmental impact	$0.519 / 1.7813 = 0.2914$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	49.1800 (1b)	x 2.5900 (2b)	= 127.3762 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	49.1800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 127.3762 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1163 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Doors			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			7.6600	1.3258	10.1553		(27)
Floor Above Street			1.6600	0.1500	0.2490	80.0000	132.8000 (28b)
External Wall	21.5000	9.7800	11.7200	0.1800	2.1096	110.0000	1289.2000 (29a)
Total net area of external elements Aum(A, m ²)			23.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	15.4819			(33)
Party Wall with Flats			52.5500	0.0000	0.0000	20.0000	1051.0000 (32)
Floor Above Retail			47.5200			80.0000	3801.6000 (32d)
Party Ceiling			49.1800			80.0000	3934.4000 (32b)
Internal Walls			71.6000			9.0000	644.4000 (32c)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (User defined value 0.080 * total exposed area)
Total fabric heat loss

(28)...(30) + (32) + (32a)...(32e) = 10853.4000 (34)												
												220.6873 (35)
												1.8528 (36)
												17.3347 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 21.0171	Feb 21.0171	Mar 21.0171	Apr 21.0171	May 21.0171	Jun 21.0171	Jul 21.0171	Aug 21.0171	Sep 21.0171	Oct 21.0171	Nov 21.0171	Dec 21.0171 (38)
Heat transfer coeff	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518	38.3518 (39)
Average = Sum(39)m / 12 =												38.3518 (39)
HLP	Jan 0.7798	Feb 0.7798	Mar 0.7798	Apr 0.7798	May 0.7798	Jun 0.7798	Jul 0.7798	Aug 0.7798	Sep 0.7798	Oct 0.7798	Nov 0.7798	Dec 0.7798 (40)
HLP (average)												0.7798 (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												1.6660 (42)
Average daily hot water use (litres/day)												73.7672 (43)
Daily hot water use	Jan 81.1439	Feb 78.1932	Mar 75.2425	Apr 72.2918	May 69.3411	Jun 66.3905	Jul 66.3905	Aug 69.3411	Sep 72.2918	Oct 75.2425	Nov 78.1932	Dec 81.1439 (44)
Energy conte	120.3340	105.2449	108.6033	94.6830	90.8506	78.3972	72.6465	83.3629	84.3585	98.3117	107.3150	116.5371 (45)
Energy content (annual)												Total = Sum(45)m = 1160.6449 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Distribution loss (46)m = 0.15 x (45)m	18.0501	15.7867	16.2905	14.2025	13.6276	11.7596	10.8970	12.5044	12.6538	14.7468	16.0972	17.4806 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395	(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	(63)
Output from w/h	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
Heat gains from water heating, kWh/month	72.0130	63.8989	68.1125	62.4517	62.2097	57.0367	56.1569	59.7201	59.0188	64.6906	66.6518	70.7505 (65)
Total per year (kWh/year) = Sum(64)m = 1631.6409 (64)												

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	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592	99.9592 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.9223	30.1295	24.5029	18.5503	13.8666	11.7067	12.6495	16.4424	22.0689	28.0215	32.7053	34.8651 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.5737	218.8210	213.1578	201.1013	185.8823	171.5785	162.0227	159.7753	165.4386	177.4950	192.7141	207.0179 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619	46.6619 (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)	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394	-66.6394 (71)
Water heating gains (Table 5)	96.7917	95.0876	91.5491	86.7385	83.6153	79.2176	75.4797	80.2689	81.9706	86.9497	92.5720	95.0948 (72)
Total internal gains	427.2692	424.0198	409.1914	386.3717	363.3457	342.4844	330.1335	336.4683	349.4597	372.4479	397.9730	416.9594 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W	
Northeast				6.4900	13.7804	0.6300	0.7000	0.7700			27.3325 (75)	
Northwest				1.1700	13.7804	0.6300	0.7000	0.7700			4.9274 (81)	
Solar gains	32.2599	57.6965	103.6029	172.5657	225.1931	253.3868	234.9395	192.7002	134.5994	75.8319	40.0577	26.4478 (83)
Total gains	459.5291	481.7163	512.7944	558.9374	588.5388	595.8712	565.0731	529.1685	484.0591	448.2798	438.0307	443.4072 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100	78.6100
alpha	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407	6.2407
util living area	0.9516	0.9313	0.8691	0.7231	0.5232	0.3344	0.2240	0.2464	0.4730	0.7591	0.9110	0.9585 (86)
Tweekday	19.8833	19.9671	20.1143	20.2319	20.2669	20.2707	20.2708	20.2708	20.2695	20.2294	20.0622	19.8532
Tweekend	20.7464	20.7969	20.8884	20.9683	20.9960	20.9998	21.0000	21.0000	20.9983	20.9646	20.8537	20.7284
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (88)
util rest of house	0.9411	0.9171	0.8449	0.6848	0.4777	0.2877	0.1745	0.1936	0.4166	0.7147	0.8908	0.9492 (89)
Tweekday	19.8833	19.9671	20.1143	20.2319	20.2669	20.2707	20.2708	20.2708	20.2695	20.2294	20.0622	19.8532
Tweekend	20.0513	20.0988	20.1822	20.2488	20.2686	20.2708	20.2709	20.2708	20.2701	20.2474	20.1527	20.0343
MIT 2	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709	20.2709 (90)
Living area fraction									fLA = Living area / (4) =			0.7544 (91)
MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (92)
Temperature adjustment												0.0000
adjusted MIT	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209	20.8209 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	436.1959	447.0387	442.7965	399.0467	301.3902	192.4473	119.6862	123.5165	222.2776	335.5915	397.0361	424.0817 (95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	602.9245	579.9134	514.7154	418.8359	303.7806	192.5605	119.6921	123.5273	223.2419	357.4731	491.7043	602.9245 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Month fraction	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	124.0460	89.2918	53.5076	14.2482	1.7785	0.0000	0.0000	0.0000	0.0000	16.2799	68.1611	133.0590 (98)
Space heating												500.3722 (98)
Space heating per m2											(98) / (4) =	10.1743 (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 %)												146.6826 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												341.1259 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	124.0460	89.2918	53.5076	14.2482	1.7785	0.0000	0.0000	0.0000	0.0000	16.2799	68.1611	133.0590 (98)
Space heating efficiency (main heating system 1)	146.6826	146.6826	146.6826	146.6826	146.6826	0.0000	0.0000	0.0000	0.0000	146.6826	146.6826	146.6826 (210)
Space heating fuel (main heating system)	84.5677	60.8742	36.4785	9.7136	1.2125	0.0000	0.0000	0.0000	0.0000	11.0987	46.4685	90.7122 (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	160.3364	141.3761	148.6057	133.3950	130.8530	117.1092	112.6489	123.3653	123.0705	138.3141	146.0270	156.5395 (64)
Efficiency of water heater (217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250 (216)
Fuel for water heating, kWh/month	90.0134	79.3691	83.4278	74.8884	73.4613	65.7455	63.2415	69.2577	69.0922	77.6500	81.9800	87.8818 (219)
Water heating fuel used												916.0089 (219)
Annual totals kWh/year												
Space heating fuel - main system												341.1259 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												34.3432 (230a)
Total electricity for the above, kWh/year												34.3432 (231)
Electricity for lighting (calculated in Appendix L)												239.6312 (232)
Total delivered energy for all uses												1531.1092 (238)

10a. Fuel costs - using BEDF prices (436)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	341.1259	16.9600	57.8550 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	916.0089	16.9600	155.3551 (247)
Mechanical ventilation fans	34.3432	16.9600	5.8246 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	239.6312	16.9600	40.6415 (250)
Additional standing charges			0.0000 (251)
Total energy cost			259.6761 (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	341.1259	0.5190	177.0443 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	916.0089	0.5190	475.4086 (264)
Space and water heating			652.4530 (265)
Pumps and fans	34.3432	0.5190	17.8241 (267)
Energy for lighting	239.6312	0.5190	124.3686 (268)
Total kg/year			794.6457 (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	341.1259	3.0700	1047.2565 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	916.0089	3.0700	2812.1473 (264)
Space and water heating			3859.4039 (265)
Pumps and fans	34.3432	3.0700	105.4335 (267)
Energy for lighting	239.6312	3.0700	735.6678 (268)
Primary energy kWh/year			4700.5052 (272)
Primary energy kWh/m2/year			95.5776 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 88

(For testing purposes):	
A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	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 87
Potential environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 436 TEST (13 Dec 2018)
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	£260	£260	£0
Space heating	£64	£64	£0
Water heating	£155	£155	£0
Lighting	£41	£41	£0
Total cost of fuels	£260	£260	£0
Total cost of uses	£260	£260	£0
Delivered energy	31 kWh/m²	31 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	96 kWh/m²	96 kWh/m²	0 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	MidTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	220.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	252.20 (P1)
Transmission heat loss coefficient	17.33 (37)
Summer heat loss coefficient	269.54 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North East	0.000	1.000	None
North West	0.000	1.000	None

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North East	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Shading	Gains W
North East	6.4900	98.8453	0.6300	0.7000	0.9000	229.1523
North West	1.1700	98.8453	0.6300	0.7000	0.9000	41.3110
total:						270.4633

	Jun	Jul	Aug	
Solar gains	292	270	221	(P3)
Internal gains	342	330	336	
Total summer gains	634	601	558	(P5)
Summer gain/loss ratio	2.35	2.23	2.07	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 220.7)	0.46	0.46	0.46	
Threshold temperature	18.81	20.58	20.32	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	21DES_BS_33			Issued on Date	10/05/2021
Assessment Reference	Be Green (ASHP + PV)	Prop Type Ref	2B4P Duplex, Top Flr		
Property	Plot '33', 86 Broad Street, Reading, Berkshire, RG1 2AP				
SAP Rating	89 B	DER	15.92	TER	21.22
Environmental	87 B	% DER<TER	24.98		
CO ₂ Emissions (t/year)	1.51	DFEE	39.80	TFEE	42.65
General Requirements Compliance	Pass	% DFEE<TFEE	6.67		
Assessor Details	Mr. Fulvio Vacca, Fulvio Vacca, Tel: 01924368145, softwaremanager@pellfrischmann.com			Assessor ID	W966-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 117 m²

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

1a TER and DER

Fuel for main heating: Electricity
Fuel factor: 1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.22 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.92 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 39.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified ψ -value of 0.080

3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

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

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.00 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, TRVs and bypass OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (Thames Valley): Not significant OK

Based on:

Overshading: Average
Windows facing North: 10.39 m², No overhang
Windows facing South: 4.81 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Air permeability 3.0 m³/m²h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.7750 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.1163 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Door			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			15.2000	1.3258	20.1515		(27)
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938	110.0000	8735.1000 (29a)
External Sloped Roof	37.8900		37.8900	0.1600	6.0624	9.0000	341.0100 (30)
External Plane Roof	29.8200		29.8200	0.1600	4.7712	9.0000	268.3800 (31)
Total net area of external elements Aum(A, m ²)			164.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.2469		(33)
Party Wall with Flat			55.4200	0.0000	0.0000	20.0000	1108.4000 (32)
Party Floor			61.1400			80.0000	4891.2000 (32d)
Party Ceiling			5.0000			80.0000	400.0000 (32b)
Internal Walls			199.3400			9.0000	1794.0600 (32c)
Internal Floor			56.1400			80.0000	4491.2000 (32d)
Internal Ceiling			56.1400			100.0000	5614.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	27643.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							235.7039 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							13.1552 (36)
Total fabric heat loss						(33) + (36) =	61.4021 (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	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186 (38)
Heat transfer coeff	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207 (39)
Average = Sum(39)m / 12 =												109.0207 (39)
HLP	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296 (40)
HLP (average)												0.9296 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)										Total =	Sum (45)m =	1603.8953 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9434	21.8157	22.5118	19.6264	18.8320	16.2506	15.0585	17.2799	17.4863	20.3786	22.2448	24.1564 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Heat gains from water heating, kWh/month	87.2932	77.2631	81.9032	74.4747	73.7461	66.9917	65.3817	70.3057	69.7308	77.1744	80.2789	85.5486 (65)
Total per year (kWh/year) = Sum (64)m =												2074.8913 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.3966	24.3334	19.7892	14.9817	11.1990	9.4547	10.2161	13.2793	17.8234	22.6310	26.4137	28.1580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.6286	284.5511	277.1866	261.5087	241.7181	223.1177	210.6915	207.7691	215.1335	230.8114	250.6021	269.2024	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	(71)
Water heating gains (Table 5)	117.3296	114.9748	110.0849	103.4371	99.1211	93.0440	87.8786	94.4969	96.8484	103.7290	111.4984	114.9847	(72)
Total internal gains	492.1372	489.6417	472.8432	445.7100	417.8207	391.3988	374.5686	381.3277	395.5877	422.9538	454.2966	478.1276	(73)

6. Solar gains

[Jan]						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
North						10.3900	10.6334	0.6300	0.7000	0.7700			33.7644 (74)
South						4.8100	46.7521	0.6300	0.7000	0.7700			68.7255 (78)
Solar gains	102.4899	177.0801	253.0192	338.1618	406.1066	416.4842	395.8993	342.3208	281.6001	198.2099	123.1159		87.5328 (83)
Total gains	594.6271	666.7219	725.8625	783.8718	823.9272	807.8830	770.4680	723.6485	677.1878	621.1637	577.4125		565.6604 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	
alpha	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	
util living area	0.9989	0.9975	0.9935	0.9784	0.9234	0.7819	0.6061	0.6642	0.8915	0.9851	0.9975	0.9991 (86)	
Tuesday	19.0098	19.1459	19.3752	19.6776	19.9583	20.1085	20.1386	20.1355	20.0517	19.7099	19.2965	18.9702	
Tuesday	20.3057	20.3830	20.5135	20.6875	20.8568	20.9626	20.9928	20.9882	20.9159	20.7046	20.4683	20.2832	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)	
Th 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (88)	
util rest of house	0.9985	0.9967	0.9913	0.9702	0.8934	0.7059	0.4963	0.5542	0.8387	0.9779	0.9965	0.9989 (89)	
Tuesday	19.0098	19.1459	19.3752	19.6776	19.9583	20.1085	20.1386	20.1355	20.0517	19.7099	19.2965	18.9702	
Tuesday	19.5009	19.5780	19.7079	19.8792	20.0381	20.1232	20.1403	20.1385	20.0910	19.8974	19.6633	19.4785	
MIT 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (90)	
Living area fraction									fLA = Living area / (4) =			0.2127 (91)	
MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9986	0.9969	0.9919	0.9722	0.9007	0.7234	0.5205	0.5788	0.8516	0.9797	0.9967	0.9989 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Useful gains	593.7799	664.6463	719.9537	762.1066	742.0872	584.4295	401.0147	418.8530	576.6639	608.5694	575.5213	565.0587 (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	1747.0424	1681.6300	1507.1969	1245.5473	940.2893	624.1294	406.0880	427.8921	678.6397	1060.2121	1441.7845	1757.9445 (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	858.0273	683.4130	585.7090	348.0773	147.4624	0.0000	0.0000	0.0000	0.0000	336.0221	623.7095	887.5070 (98)
Space heating												4469.9278 (98)
Space heating per m2											(98) / (4) =	38.1133 (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 %)												230.5537 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1938.7798 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	858.0273	683.4130	585.7090	348.0773	147.4624	0.0000	0.0000	0.0000	0.0000	336.0221	623.7095	887.5070 (98)
Space heating efficiency (main heating system 1)	230.5537	230.5537	230.5537	230.5537	230.5537	0.0000	0.0000	0.0000	0.0000	230.5537	230.5537	230.5537 (210)
Space heating fuel (main heating system)	372.1595	296.4226	254.0445	150.9745	63.9601	0.0000	0.0000	0.0000	0.0000	145.7457	270.5268	384.9460 (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 requirement	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	109.1752	96.0912	100.5961	89.7327	87.6129	77.8223	74.2995	82.1368	82.1820	93.0695	98.9709	106.3984 (219)
Fuel for water heating, kWh/month												1098.0875 (219)
Water heating fuel used												
Annual totals kWh/year												
Space heating fuel - main system												1938.7798 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												77.8116 (230a)
Total electricity for the above, kWh/year												77.8116 (231)
Electricity for lighting (calculated in Appendix L)												483.8319 (232)
Total delivered energy for all uses												3598.5108 (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	1938.7798	0.5190	1006.2267 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1098.0875	0.5190	569.9074 (264)
Space and water heating			1576.1342 (265)
Pumps and fans	77.8116	0.5190	40.3842 (267)
Energy for lighting	483.8319	0.5190	251.1087 (268)
Total CO2, kg/year			1867.6271 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9200 (273)

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

DER		15.9200 ZC1
Total Floor Area	TFA	117.2800
Assumed number of occupants	N	2.8522
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		14.2298 ZC2
CO2 emissions from cooking, equation (L16)		1.5983 ZC3
Total CO2 emissions		31.7481 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		31.7481 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
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) =							0.1386 (8)
Pressure test										Yes							
Measured/design AP50																	5.0000
Infiltration rate																	0.3886 (18)
Number of sides sheltered																	3 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							0.7750 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.3012 (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	0.3840	0.3765	0.3689	0.3313	0.3238	0.2861	0.2861	0.2786	0.3012	0.3238	0.3388	0.3539	(22b)				
Effective ac	0.5737	0.5709	0.5681	0.5549	0.5524	0.5409	0.5409	0.5388	0.5454	0.5524	0.5574	0.5626	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			15.2000	1.3258	20.1515		(27)					
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938		(29a)					
External Sloped Roof	37.8900		37.8900	0.1300	4.9257		(30)					
External Plane Roof	29.8200		29.8200	0.1300	3.8766		(30)					
Total net area of external elements Aum(A, m2)			164.4400				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.3676		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.7725 (36)					
Total fabric heat loss						(33) + (36) =	53.1401 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 54.6397	Feb 54.3671	Mar 54.0998	Apr 52.8446	May 52.6098	Jun 51.5165	Jul 51.5165	Aug 51.3141	Sep 51.9376	Oct 52.6098	Nov 53.0849	Dec 53.5816 (38)
Heat transfer coeff	107.7798	107.5072	107.2400	105.9847	105.7499	104.6566	104.6566	104.4542	105.0777	105.7499	106.2250	106.7217 (39)
Average = Sum(39)m / 12 =												105.9836 (39)
HLP	Jan 0.9190	Feb 0.9167	Mar 0.9144	Apr 0.9037	May 0.9017	Jun 0.8924	Jul 0.8924	Aug 0.8906	Sep 0.8960	Oct 0.9017	Nov 0.9057	Dec 0.9100 (40)
HLP (average)												0.9037 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)											Total = Sum(45)m =	1603.8953 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.9434	21.8157	22.5118	19.6264	18.8320	16.2506	15.0585	17.2799	17.4863	20.3786	22.2448	24.1564 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003 (48)
Temperature factor from Table 2b												0.5400 (49)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.8102 (55)
Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	214.6673	189.1340	198.4567	177.6596	173.9242	155.1542	148.7679	163.5769	163.3922	184.2347	195.1157	209.4203 (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)
Output from w/h	214.6673	189.1340	198.4567	177.6596	173.9242	155.1542	148.7679	163.5769	163.3922	184.2347	195.1157	209.4203 (64)
Heat gains from water heating, kWh/month	93.9935	83.3149	88.6034	80.9588	80.4464	73.4758	72.0819	77.0059	76.2149	83.8746	86.7630	92.2488 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.3966	24.3334	19.7892	14.9817	11.1990	9.4547	10.2161	13.2793	17.8234	22.6310	26.4137	28.1580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.6286	284.5511	277.1866	261.5087	241.7181	223.1177	210.6915	207.7691	215.1335	230.8114	250.6021	269.2024	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	(71)
Water heating gains (Table 5)	126.3353	123.9805	119.0906	112.4428	108.1268	102.0497	96.8843	103.5026	105.8541	112.7347	120.5041	123.9904	(72)
Total internal gains	504.1429	501.6474	484.8489	457.7157	429.8264	403.4045	386.5743	393.3334	407.5934	434.9595	466.3023	490.1333	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					10.3900	10.6334	0.6300	0.7000			0.7700			33.7644 (74)
South					4.8100	46.7521	0.6300	0.7000			0.7700			68.7255 (78)

Solar gains	102.4899	177.0801	253.0192	338.1618	406.1066	416.4842	395.8993	342.3208	281.6001	198.2099	123.1159			87.5328 (83)
Total gains	606.6328	678.7276	737.8682	795.8775	835.9329	819.8887	782.4737	735.6542	689.1935	633.1694	589.4182			577.6661 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	75.5656	75.7572	75.9460	76.8454	77.0161	77.8206	77.8206	77.9715	77.5088	77.0161	76.6716	76.3148	
alpha	6.0377	6.0505	6.0631	6.1230	6.1344	6.1880	6.1880	6.1981	6.1673	6.1344	6.1114	6.0877	
util living area	0.9991	0.9979	0.9942	0.9789	0.9194	0.7611	0.5792	0.6362	0.8813	0.9854	0.9978	0.9993	(86)
MIT	20.0020	20.1189	20.3128	20.5780	20.8197	20.9615	20.9939	20.9895	20.9012	20.6009	20.2555	19.9820	(87)
Th 2	20.1514	20.1534	20.1553	20.1644	20.1661	20.1740	20.1740	20.1755	20.1709	20.1661	20.1626	20.1590	(88)
util rest of house	0.9988	0.9972	0.9922	0.9705	0.8875	0.6842	0.4754	0.5308	0.8251	0.9781	0.9969	0.9991	(89)
MIT 2	18.8014	18.9737	19.2579	19.6469	19.9777	20.1464	20.1715	20.1707	20.0858	19.6842	19.1807	18.7780	(90)
Living area fraction	19.0568	19.2173	19.4823	19.8449	20.1568	20.3198	20.3464	20.3449	20.2592	19.8792	19.4093	19.0341	(92)
Temperature adjustment	19.0568	19.2173	19.4823	19.8449	20.1568	20.3198	20.3464	20.3449	20.2592	19.8792	19.4093	19.0341	(93)
adjusted MIT	19.0568	19.2173	19.4823	19.8449	20.1568	20.3198	20.3464	20.3449	20.2592	19.8792	19.4093	19.0341	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	605.5175	676.0427	730.3994	769.1735	741.5717	572.8642	389.3514	406.9909	573.4268	617.1831	586.9242	576.8727	(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	1590.4870	1539.2160	1392.2207	1159.9973	894.3059	598.6159	392.0899	412.0595	647.2000	981.2713	1307.5577	1583.1212	(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	732.8174	580.0525	492.3950	281.3932	113.6342	0.0000	0.0000	0.0000	0.0000	270.8816	518.8561	748.6489	(98)
Space heating												3738.6789	(98)
Space heating per m ²												31.8782	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3998.5870 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	732.8174	580.0525	492.3950	281.3932	113.6342	0.0000	0.0000	0.0000	0.0000	270.8816	518.8561	748.6489	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	783.7619	620.3770	526.6257	300.9553	121.5339	0.0000	0.0000	0.0000	0.0000	289.7130	554.9263	800.6940	(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 requirement	214.6673	189.1340	198.4567	177.6596	173.9242	155.1542	148.7679	163.5769	163.3922	184.2347	195.1157	209.4203	(64)
Efficiency of water heater (217)m	87.8318	87.6115	87.1434	86.0354	83.7111	79.8000	79.8000	79.8000	79.8000	85.8407	87.3010	87.9231	(216)
Fuel for water heating, kWh/month	244.4074	215.8781	227.7357	206.4960	207.7671	194.4288	186.4260	204.9836	204.7521	214.6240	223.4976	238.1859	(219)
Water heating fuel used												2569.1824	(219)
Annual totals kWh/year													
Space heating fuel - main system												3998.5870	(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)												483.8319	(232)
Total delivered energy for all uses												7126.6013	(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	3998.5870	0.2160	863.6948 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2569.1824	0.2160	554.9434 (264)
Space and water heating			1418.6382 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	483.8319	0.5190	251.1087 (268)
Total CO2, kg/m2/year			1708.6719 (272)
Emissions per m2 for space and water heating			12.0962 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.1411 (272b)
Emissions per m2 for pumps and fans			0.3319 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0962 * 1.55) + 2.1411 + 0.3319, rounded to 2 d.p.			21.2200 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1386 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.2886 (18)
Number of sides sheltered					3 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2237 (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	0.2852	0.2796	0.2740	0.2460	0.2404	0.2125	0.2125	0.2069	0.2237	0.2404	0.2516	0.2628 (22b)
Effective ac	0.5407	0.5391	0.5375	0.5303	0.5289	0.5226	0.5226	0.5214	0.5250	0.5289	0.5317	0.5345 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Door			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			15.2000	1.3258	20.1515		(27)
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938	110.0000	8735.1000 (29a)
External Sloped Roof	37.8900		37.8900	0.1600	6.0624	9.0000	341.0100 (30)
External Plane Roof	29.8200		29.8200	0.1600	4.7712	9.0000	268.3800 (30)
Total net area of external elements Aum(A, m ²)			164.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.2469		(33)
Party Wall with Flat			55.4200	0.0000	0.0000	20.0000	1108.4000 (32)
Party Floor			61.1400			80.0000	4891.2000 (32d)
Party Ceiling			5.0000			100.0000	500.0000 (32b)
Internal Walls			199.3400			9.0000	1794.0600 (32c)
Internal Floor			56.1400			80.0000	4491.2000 (32d)
Internal Ceiling			56.1400			100.0000	5614.0000 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (User defined value 0.080 * total exposed area)
Total fabric heat loss

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	51.4911	51.3407	51.1933	50.5010	50.3715	49.7685	49.7685	49.6568	50.0008	50.3715	50.6335	50.9075 (38)
Average = Sum(39)m / 12 =	112.8932	112.7429	112.5955	111.9031	111.7736	111.1706	111.1706	111.0589	111.4029	111.7736	112.0356	112.3096 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9626	0.9613	0.9601	0.9542	0.9530	0.9479	0.9479	0.9470	0.9499	0.9530	0.9553	0.9576 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1603.8953 (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	35.3365	30.9056	31.8918	27.8040	26.6786	23.0216	21.3329	24.4798	24.7722	28.8696	31.5134	34.2216 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.3966	24.3334	19.7892	14.9817	11.1990	9.4547	10.2161	13.2793	17.8234	22.6310	26.4137	28.1580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.6286	284.5511	277.1866	261.5087	241.7181	223.1177	210.6915	207.7691	215.1335	230.8114	250.6021	269.2024	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	(71)
Water heating gains (Table 5)	47.4954	45.9904	42.8653	38.6167	35.8584	31.9745	28.6733	32.9030	34.4058	38.8032	43.7687	45.9967	(72)
Total internal gains	422.3030	420.6573	405.6236	380.8896	354.5579	330.3293	315.3633	319.7338	333.1452	358.0281	386.5668	409.1396	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c				Access factor Table 6d			Gains W	
North					10.3900	10.6334	0.6300	0.7000				0.7700			33.7644	(74)
South					4.8100	46.7521	0.6300	0.7000				0.7700			68.7255	(78)
Solar gains	102.4899	177.0801	253.0192	338.1618	406.1066	416.4842	395.8993	342.3208	281.6001	198.2099	123.1159			87.5328	(83)	
Total gains	524.7929	597.7375	658.6429	719.0514	760.6645	746.8135	711.2627	662.0546	614.7453	556.2380	509.6827			496.6724	(84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.2635	68.3545	68.4440	68.8675	68.9473	69.3213	69.3213	69.3910	69.1767	68.9473	68.7860	68.6182	
alpha	5.5509	5.5570	5.5629	5.5912	5.5965	5.6214	5.6214	5.6261	5.6118	5.5965	5.5857	5.5745	
util living area	0.9994	0.9986	0.9962	0.9862	0.9465	0.8277	0.6591	0.7217	0.9260	0.9915	0.9987	0.9996	(86)
MIT	19.8198	19.9432	20.1527	20.4398	20.7223	20.9188	20.9823	20.9712	20.8266	20.4692	20.0896	19.7930	(87)
Th 2	20.1146	20.1157	20.1168	20.1217	20.1226	20.1270	20.1270	20.1278	20.1253	20.1226	20.1208	20.1188	(88)
util rest of house	0.9992	0.9981	0.9948	0.9806	0.9229	0.7556	0.5424	0.6079	0.8834	0.9872	0.9982	0.9994	(89)
MIT 2	19.0210	19.1451	19.3549	19.6434	19.9146	20.0834	20.1215	20.1177	20.0139	19.6749	19.2956	18.9977	(90)
Living area fraction	19.1910	19.3149	19.5247	19.8128	20.0864	20.2611	20.3046	20.2993	20.1868	19.8439	19.4645	19.1669	(92)
Temperature adjustment	19.1910	19.3149	19.5247	19.8128	20.0864	20.2611	20.3046	20.2993	20.1868	19.8439	19.4645	19.1669	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	524.2291	596.2783	654.3957	703.2693	701.1025	573.5531	403.5869	418.4224	545.3274	548.0748	508.4717	496.2811	(94)
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	1681.0883	1625.1785	1466.5172	1221.1747	937.3828	629.3457	411.8444	433.0504	678.0844	1033.2235	1385.2695	1680.9252	(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	860.7033	691.4209	604.2184	372.8919	175.7925	0.0000	0.0000	0.0000	0.0000	360.9506	631.2944	881.3752	(98)
Space heating													4578.6473 (98)
Space heating per m2													39.0403 (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	1045.0038	822.6625	844.0480	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8239	0.9006	0.8699	0.0000	0.0000	0.0000	0.0000	(101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	860.9880	740.8862	734.2443	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.4308	943.4263	888.3280	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	91.0388	150.6899	114.6383	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												356.3669 (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	22.7597	37.6725	28.6596	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												89.0917 (107)
Space cooling per m2												0.7596 (108)
Energy for space heating												39.0403 (99)
Energy for space cooling												0.7596 (108)
Total												39.8000 (109)
Dwelling Fabric Energy Efficiency (DFEE)												39.8 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1386 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3886 (18)
Number of sides sheltered					3 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3012 (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	0.3840	0.3765	0.3689	0.3313	0.3238	0.2861	0.2861	0.2786	0.3012	0.3238	0.3388	0.3539 (22b)
Effective ac	0.5737	0.5709	0.5681	0.5549	0.5524	0.5409	0.5409	0.5388	0.5454	0.5524	0.5574	0.5626 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			15.2000	1.3258	20.1515		(27)
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938		(29a)
External Sloped Roof	37.8900		37.8900	0.1300	4.9257		(30)
External Plane Roof	29.8200		29.8200	0.1300	3.8766		(30)
Total net area of external elements Aum(A, m ²)			164.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.3676		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.7725 (36)
Total fabric heat loss						(33) + (36) =	53.1401 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	54.6397	54.3671	54.0998	52.8446	52.6098	51.5165	51.5165	51.3141	51.9376	52.6098	53.0849	53.5816 (38)
Heat transfer coeff	107.7798	107.5072	107.2400	105.9847	105.7499	104.6566	104.6566	104.4542	105.0777	105.7499	106.2250	106.7217 (39)
Average = Sum(39)m / 12 =												105.9836 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9190	0.9167	0.9144	0.9037	0.9017	0.8924	0.8924	0.8906	0.8960	0.9017	0.9057	0.9100 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)										Total = Sum(45)m =		1603.8953 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (57)
Heat gains from water heating, kWh/month	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)
	35.3365	30.9056	31.8918	27.8040	26.6786	23.0216	21.3329	24.4798	24.7722	28.8696	31.5134	34.2216 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	142.6081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.3966	24.3334	19.7892	14.9817	11.1990	9.4547	10.2161	13.2793	17.8234	22.6310	26.4137	28.1580	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.6286	284.5511	277.1866	261.5087	241.7181	223.1177	210.6915	207.7691	215.1335	230.8114	250.6021	269.2024	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	37.2608	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	(71)
Water heating gains (Table 5)	47.4954	45.9904	42.8653	38.6167	35.8584	31.9745	28.6733	32.9030	34.4058	38.8032	43.7687	45.9967	(72)
Total internal gains	422.3030	420.6573	405.6236	380.8896	354.5579	330.3293	315.3633	319.7338	333.1452	358.0281	386.5668	409.1396	(73)

6. Solar gains

[Jan]					Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					10.3900	10.6334	0.6300	0.7000			0.7700	33.7644
South					4.8100	46.7521	0.6300	0.7000			0.7700	68.7255 (74)
Solar gains	102.4899	177.0801	253.0192	338.1618	406.1066	416.4842	395.8993	342.3208	281.6001	198.2099	123.1159	87.5328 (83)
Total gains	524.7929	597.7375	658.6429	719.0514	760.6645	746.8135	711.2627	662.0546	614.7453	556.2380	509.6827	496.6724 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	75.5656	75.7572	75.9460	76.8454	77.0161	77.8206	77.8206	77.9715	77.5088	77.0161	76.6716	76.3148	
alpha	6.0377	6.0505	6.0631	6.1230	6.1344	6.1880	6.1880	6.1981	6.1673	6.1344	6.1114	6.0877	
util living area	0.9996	0.9989	0.9968	0.9871	0.9442	0.8100	0.6312	0.6954	0.9207	0.9924	0.9990	0.9997	(86)
MIT	19.9339	20.0518	20.2483	20.5199	20.7775	20.9455	20.9903	20.9831	20.8665	20.5406	20.1893	19.9144	(87)
Th 2	20.1514	20.1534	20.1553	20.1644	20.1661	20.1740	20.1740	20.1755	20.1709	20.1661	20.1626	20.1590	(88)
util rest of house	0.9994	0.9986	0.9957	0.9817	0.9195	0.7365	0.5212	0.5857	0.8759	0.9884	0.9986	0.9996	(89)
MIT 2	19.1616	19.2811	19.4787	19.7552	20.0018	20.1460	20.1712	20.1699	20.0874	19.7787	19.4263	19.1486	(90)
Living area fraction	19.3259	19.4451	19.6424	19.9179	20.1668	20.3161	20.3454	20.3429	20.2532	19.9408	19.5886	19.3115	(91)
MIT	19.3259	19.4451	19.6424	19.9179	20.1668	20.3161	20.3454	20.3429	20.2532	19.9408	19.5886	19.3115	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3259	19.4451	19.6424	19.9179	20.1668	20.3161	20.3454	20.3429	20.2532	19.9408	19.5886	19.3115	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9992	0.9982	0.9947	0.9796	0.9195	0.7504	0.5448	0.6093	0.8812	0.9869	0.9982	0.9995	(94)
Ext temp.	524.3991	596.6388	655.1434	704.3991	699.4403	560.3834	387.5157	403.3655	541.7234	548.9439	508.7743	496.4078	(95)
Heat loss rate W	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)
Month fracti	1619.4919	1563.6987	1409.3953	1167.7305	895.3655	598.2243	391.9848	411.8553	646.5592	987.7865	1326.6028	1612.7222	(97)
Space heating kWh	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	814.7490	649.8643	561.1634	333.5986	145.7683	0.0000	0.0000	0.0000	0.0000	326.4989	588.8366	830.5379	(98)
Space heating per m2												4251.0170	(98)
												36.2467	(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	983.7723	774.4591	793.8517	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8625	0.9303	0.9045	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.4767	720.4978	718.0601	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.4308	943.4263	888.3280	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	100.0469	165.8588	126.6793	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												392.5850	(104)
Cooled fraction												1.0000	(105)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)	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	25.0117	41.4647	31.6698	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											98.1463 (107)
Space cooling per m2											0.8369 (108)
Energy for space heating											36.2467 (99)
Energy for space cooling											0.8369 (108)
Total											37.0836 (109)
Target Fabric Energy Efficiency (TFEE)											42.6 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.7750 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.1163 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Door			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			15.2000	1.3258	20.1515		(27)
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938	110.0000	8735.1000 (29a)
External Sloped Roof	37.8900		37.8900	0.1600	6.0624	9.0000	341.0100 (30)
External Plane Roof	29.8200		29.8200	0.1600	4.7712	9.0000	268.3800 (31)
Total net area of external elements Aum(A, m ²)			164.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.2469		(33)
Party Wall with Flat			55.4200	0.0000	0.0000	20.0000	1108.4000 (32)
Party Floor			61.1400			80.0000	4891.2000 (32d)
Party Ceiling			5.0000			80.0000	400.0000 (32b)
Internal Walls			199.3400			9.0000	1794.0600 (32c)
Internal Floor			56.1400			80.0000	4491.2000 (32d)
Internal Ceiling			56.1400			100.0000	5614.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27643.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 235.7039 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 13.1552 (36)
Total fabric heat loss (33) + (36) = 61.4021 (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	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186 (38)
Heat transfer coeff	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207 (39)
Average = Sum(39)m / 12 =												109.0207 (39)
HLP	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296 (40)
HLP (average)												0.9296 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)										Total = Sum (45)m =		1603.8953 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9434	21.8157	22.5118	19.6264	18.8320	16.2506	15.0585	17.2799	17.4863	20.3786	22.2448	24.1564 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
RHI water heating demand												2074.8913 (64)
Heat gains from water heating, kWh/month	87.2932	77.2631	81.9032	74.4747	73.7461	66.9917	65.3817	70.3057	69.7308	77.1744	80.2789	85.5486 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.4914	60.8335	49.4731	37.4543	27.9975	23.6367	25.5403	33.1982	44.5586	56.5774	66.0342	70.3950 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	420.3413	424.7031	413.7114	390.3115	360.7732	333.0115	314.4649	310.1031	321.0947	344.4947	374.0329	401.7947 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865 (71)
Water heating gains (Table 5)	117.3296	114.9748	110.0849	103.4371	99.1211	93.0440	87.8786	94.4969	96.8484	103.7290	111.4984	114.9847 (72)
Total internal gains	718.1707	712.5198	685.2778	643.2113	599.9003	561.7006	539.8922	549.8066	574.5101	616.8095	663.5739	699.1827 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					10.3900	12.7650	0.6300	0.7000			0.7700			40.5331 (74)
South					4.8100	54.2217	0.6300	0.7000			0.7700			79.7058 (78)
Solar gains	120.2389	182.0609	260.1193	356.3840	419.5423	456.0000	428.8634	378.5609	309.8152	219.2221	142.3773	103.2349 (83)		
Total gains	838.4096	894.5807	945.3971	999.5953	1019.4427	1017.7006	968.7556	928.3674	884.3253	836.0316	805.9512	802.4177 (84)		

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335
alpha	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956
util living area	0.9917	0.9865	0.9706	0.9189	0.7834	0.5481	0.3705	0.3980	0.6998	0.9253	0.9823	0.9933 (86)
Tweekday	19.3324	19.4472	19.6625	19.9190	20.0918	20.1392	20.1423	20.1422	20.1264	19.9498	19.6056	19.2984
Tweekend	20.4895	20.5554	20.6802	20.8349	20.9522	20.9948	20.9995	20.9993	20.9800	20.8516	20.6459	20.4700
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (88)
util rest of house	0.9892	0.9823	0.9614	0.8934	0.7248	0.4620	0.2747	0.2984	0.6158	0.8965	0.9760	0.9912 (89)
Tweekday	19.3324	19.4472	19.6625	19.9190	20.0918	20.1392	20.1423	20.1422	20.1264	19.9498	19.6056	19.2984
Tweekend	19.6836	19.7487	19.8706	20.0159	20.1137	20.1406	20.1424	20.1423	20.1333	20.0334	19.8384	19.6644
MIT 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (90)
Living area fraction									fLA = Living area / (4) =			0.2127 (91)
MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (93)

8. Space heating requirement

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Utilisation	0.9898	0.9833	0.9636	0.8994	0.7381	0.4807	0.2952	0.3197	0.6346	0.9034	0.9775	0.9917 (94)
Useful gains	829.8367	879.6634	910.9750	899.0720	752.4746	489.1618	285.9710	296.7604	561.2270	755.2695	787.8101	795.7648 (95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	1659.8259	1594.4135	1409.0783	1136.5266	809.4645	493.3045	286.1652	297.0673	580.5211	962.0935	1343.6659	1659.8259 (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	617.5119	480.3121	370.5889	170.9673	42.4005	0.0000	0.0000	0.0000	0.0000	153.8771	400.2161	642.8614 (98)
Space heating												2878.7353 (98)
RHI space heating demand												2879 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (18)
Number of sides sheltered					3 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.7750 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.1163 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Entrance Door			2.1200	1.4000	2.9680		(26)
Windows & Glazed Doors (Uw = 1.40)			15.2000	1.3258	20.1515		(27)
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938	110.0000	8735.1000 (29a)
External Sloped Roof	37.8900		37.8900	0.1600	6.0624	9.0000	341.0100 (30)
External Plane Roof	29.8200		29.8200	0.1600	4.7712	9.0000	268.3800 (31)
Total net area of external elements Aum(A, m ²)			164.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.2469		(33)
Party Wall with Flat			55.4200	0.0000	0.0000	20.0000	1108.4000 (32)
Party Floor			61.1400			80.0000	4891.2000 (32d)
Party Ceiling			5.0000			80.0000	400.0000 (32b)
Internal Walls			199.3400			9.0000	1794.0600 (32c)
Internal Floor			56.1400			80.0000	4491.2000 (32d)
Internal Ceiling			56.1400			100.0000	5614.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27643.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 235.7039 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 13.1552 (36)
Total fabric heat loss (33) + (36) = 61.4021 (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	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186	47.6186 (38)
Heat transfer coeff	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207 (39)
Average = Sum(39)m / 12 =												109.0207 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296	0.9296 (40)
HLP (average)												0.9296 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)										Total =	Sum (45)m =	1603.8953 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9434	21.8157	22.5118	19.6264	18.8320	16.2506	15.0585	17.2799	17.4863	20.3786	22.2448	24.1564 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Heat gains from water heating, kWh/month	87.2932	77.2631	81.9032	74.4747	73.7461	66.9917	65.3817	70.3057	69.7308	77.1744	80.2789	85.5486 (65)
Total per year (kWh/year) = Sum (64)m =												2074.8913 (64)

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	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.4914	60.8335	49.4731	37.4543	27.9975	23.6367	25.5403	33.1982	44.5586	56.5774	66.0342	70.3950 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	420.3413	424.7031	413.7114	390.3115	360.7732	333.0115	314.4649	310.1031	321.0947	344.4947	374.0329	401.7947 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865 (71)
Water heating gains (Table 5)	117.3296	114.9748	110.0849	103.4371	99.1211	93.0440	87.8786	94.4969	96.8484	103.7290	111.4984	114.9847 (72)
Total internal gains	718.1707	712.5198	685.2778	643.2113	599.9003	561.7006	539.8922	549.8066	574.5101	616.8095	663.5739	699.1827 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					10.3900	10.6334	0.6300	0.7000			0.7700			33.7644
South					4.8100	46.7521	0.6300	0.7000			0.7700			68.7255 (78)
Solar gains	102.4899	177.0801	253.0192	338.1618	406.1066	416.4842	395.8993	342.3208	281.6001	198.2099	123.1159	87.5328 (83)		
Total gains	820.6605	889.5999	938.2971	981.3731	1006.0069	978.1848	935.7915	892.1274	856.1102	815.0194	786.6898	786.7156 (84)		

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335
alpha	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956
util living area	0.9941	0.9896	0.9785	0.9449	0.8539	0.6800	0.5070	0.5527	0.7906	0.9518	0.9884	0.9953 (86)
Tuesday	19.2303	19.3589	19.5675	19.8271	20.0373	20.1270	20.1410	20.1399	20.1012	19.8627	19.4954	19.1870
Tuesday	20.4313	20.5048	20.6249	20.7782	20.9124	20.9816	20.9970	20.9952	20.9573	20.7973	20.5824	20.4066
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (88)
util rest of house	0.9924	0.9866	0.9719	0.9274	0.8104	0.6019	0.4111	0.4544	0.7213	0.9330	0.9844	0.9940 (89)
Tuesday	19.2303	19.3589	19.5675	19.8271	20.0373	20.1270	20.1410	20.1399	20.1012	19.8627	19.4954	19.1870
Tuesday	19.6258	19.6986	19.8168	19.9639	20.0829	20.1337	20.1416	20.1410	20.1191	19.9840	19.7760	19.6013
MIT 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (90)
Living area fraction									fLA = Living area / (4) =			0.2127 (91)
MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9928	0.9873	0.9735	0.9316	0.8205	0.6193	0.4318	0.4758	0.7372	0.9376	0.9853	0.9943 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Useful gains	814.7384	878.2932	913.4392	914.2151	825.3924	605.7453	404.1013	424.4769	631.1517	764.1321	775.1471	782.2352 (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	1747.0424	1681.6300	1507.1969	1245.5473	940.2893	624.1294	406.0880	427.8921	678.6397	1060.2121	1441.7845	1757.9445 (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	693.6342	539.8423	441.7557	238.5592	85.4833	0.0000	0.0000	0.0000	0.0000	220.2835	479.9789	725.9277 (98)
Space heating												3425.4648 (98)
Space heating per m2											(98) / (4) =	29.2076 (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 %)												230.5537 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1485.7560 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	693.6342	539.8423	441.7557	238.5592	85.4833	0.0000	0.0000	0.0000	0.0000	220.2835	479.9789	725.9277 (98)
Space heating efficiency (main heating system 1)	230.5537	230.5537	230.5537	230.5537	230.5537	0.0000	0.0000	0.0000	0.0000	230.5537	230.5537	230.5537 (210)
Space heating fuel (main heating system)	300.8558	234.1504	191.6065	103.4723	37.0774	0.0000	0.0000	0.0000	0.0000	95.5454	208.1854	314.8628 (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 requirement	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (217)
Fuel for water heating, kWh/month	109.1752	96.0912	100.5961	89.7327	87.6129	77.8223	74.2995	82.1368	82.1820	93.0695	98.9709	106.3984 (219)
Water heating fuel used												1098.0875 (219)
Annual totals kWh/year												
Space heating fuel - main system												1485.7560 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												77.8116 (230a)
Total electricity for the above, kWh/year												77.8116 (231)
Electricity for lighting (calculated in Appendix L)												483.8319 (232)
Total delivered energy for all uses												3145.4870 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1485.7560	6.6100	98.2085 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1098.0875	6.6100	72.5836 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	483.8319	13.1900	63.8174 (250)
Additional standing charges			70.0000 (251)
Total energy cost			304.6095 (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] =	0.7884 (257)
SAP value		89.0023
SAP rating (Section 12)		89 (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	1485.7560	0.5190	771.1074 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1098.0875	0.5190	569.9074 (264)
Space and water heating			1341.0148 (265)
Pumps and fans	77.8116	0.5190	40.3842 (267)
Energy for lighting	483.8319	0.5190	251.1087 (268)
Total kg/year			1632.5078 (272)
CO2 emissions per m2			13.9200 (273)
EI value			86.5198
EI rating			87 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	$6.61 \times (1 + 0.29 \times 0.00) / 2.3055 = 2.867$, stars = 5
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 2.3055 = 0.2251$, stars = 4
Water heating energy efficiency	$6.61 / 1.8896 = 3.498$, stars = 5
Water heating environmental impact	$0.519 / 1.8896 = 0.2747$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	61.1400 (1b)	x 2.5900 (2b)	= 158.3526 (1b) - (3b)
First floor	56.1400 (1c)	x 2.3200 (2c)	= 130.2448 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 288.5974 (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											0 * 10 =	0.0000 (7a)
Number of passive vents											0 * 10 =	0.0000 (7b)
Number of flueless gas fires											0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =										0.0000 / (5) =	0.0000 (8)
Pressure test											Yes	
Measured/design AP50											3.0000	
Infiltration rate											0.1500	(18)
Number of sides sheltered											3	(19)
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.1163 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate												
	0.1250	0.1192	0.1192	0.1104	0.1133	0.0988	0.0988	0.0959	0.0988	0.1104	0.1075	0.1163 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												
	0.5000 (23a)											
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (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					
Entrance Door			2.1200	1.4000	2.9680		(26)					
Windows & Glazed Doors (Uw = 1.40)			15.2000	1.3258	20.1515		(27)					
External Wall	96.7300	17.3200	79.4100	0.1800	14.2938	110.0000	8735.1000 (29a)					
External Sloped Roof	37.8900		37.8900	0.1600	6.0624	9.0000	341.0100 (30)					
External Plane Roof	29.8200		29.8200	0.1600	4.7712	9.0000	268.3800 (30)					
Total net area of external elements Aum(A, m2)			164.4400				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		48.2469		(33)					
Party Wall with Flat			55.4200	0.0000	0.0000	20.0000	1108.4000 (32)					
Party Floor			61.1400			80.0000	4891.2000 (32d)					
Party Ceiling			5.0000			80.0000	400.0000 (32b)					
Internal Walls			199.3400			9.0000	1794.0600 (32c)					
Internal Floor			56.1400			80.0000	4491.2000 (32d)					
Internal Ceiling			56.1400			100.0000	5614.0000 (32e)					
Heat capacity Cm = Sum(A x k)					(28) ... (30) + (32) + (32a) ... (32e) =		27643.3500 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							235.7039 (35)					
Thermal bridges (User defined value 0.080 * total exposed area)							13.1552 (36)					
Total fabric heat loss						(33) + (36) =	61.4021 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 47.6186	Feb 47.6186	Mar 47.6186	Apr 47.6186	May 47.6186	Jun 47.6186	Jul 47.6186	Aug 47.6186	Sep 47.6186	Oct 47.6186	Nov 47.6186	Dec 47.6186 (38)
Heat transfer coeff	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207	109.0207 (39)
Average = Sum(39)m / 12 =												109.0207 (39)
HLP	Jan 0.9296	Feb 0.9296	Mar 0.9296	Apr 0.9296	May 0.9296	Jun 0.9296	Jul 0.9296	Aug 0.9296	Sep 0.9296	Oct 0.9296	Nov 0.9296	Dec 0.9296 (40)
HLP (average)												0.9296 (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												2.8522 (42)
Average daily hot water use (litres/day)												101.9389 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Daily hot water use	112.1328	108.0552	103.9776	99.9001	95.8225	91.7450	91.7450	95.8225	99.9001	103.9776	108.0552	112.1328 (44)
Energy conte	166.2896	145.4380	150.0790	130.8425	125.5465	108.3371	100.3902	115.1992	116.5751	135.8570	148.2986	161.0426 (45)
Energy content (annual)										Total =	Sum (45)m =	1603.8953 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9434	21.8157	22.5118	19.6264	18.8320	16.2506	15.0585	17.2799	17.4863	20.3786	22.2448	24.1564 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Heat gains from water heating, kWh/month	87.2932	77.2631	81.9032	74.4747	73.7461	66.9917	65.3817	70.3057	69.7308	77.1744	80.2789	85.5486 (65)
Total per year (kWh/year) = Sum (64)m =												2074.8913 (64)

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	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298	171.1298 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.4914	60.8335	49.4731	37.4543	27.9975	23.6367	25.5403	33.1982	44.5586	56.5774	66.0342	70.3950 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	420.3413	424.7031	413.7114	390.3115	360.7732	333.0115	314.4649	310.1031	321.0947	344.4947	374.0329	401.7947 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651	54.9651 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865	-114.0865 (71)
Water heating gains (Table 5)	117.3296	114.9748	110.0849	103.4371	99.1211	93.0440	87.8786	94.4969	96.8484	103.7290	111.4984	114.9847 (72)
Total internal gains	718.1707	712.5198	685.2778	643.2113	599.9003	561.7006	539.8922	549.8066	574.5101	616.8095	663.5739	699.1827 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
North					10.3900	12.7650		0.6300	0.7000	0.7700			40.5331 (74)
South					4.8100	54.2217		0.6300	0.7000	0.7700			79.7058 (78)
Solar gains	120.2389	182.0609	260.1193	356.3840	419.5423	456.0000	428.8634	378.5609	309.8152	219.2221	142.3773	103.2349 (83)	
Total gains	838.4096	894.5807	945.3971	999.5953	1019.4427	1017.7006	968.7556	928.3674	884.3253	836.0316	805.9512	802.4177 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335	70.4335
alpha	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956	5.6956
util living area	0.9917	0.9865	0.9706	0.9189	0.7834	0.5481	0.3705	0.3980	0.6998	0.9253	0.9823	0.9933 (86)
Tweekday	19.3324	19.4472	19.6625	19.9190	20.0918	20.1392	20.1423	20.1422	20.1264	19.9498	19.6056	19.2984
Tweekend	20.4895	20.5554	20.6802	20.8349	20.9522	20.9948	20.9995	20.9993	20.9800	20.8516	20.6459	20.4700
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (88)
util rest of house	0.9892	0.9823	0.9614	0.8934	0.7248	0.4620	0.2747	0.2984	0.6158	0.8965	0.9760	0.9912 (89)
Tweekday	19.3324	19.4472	19.6625	19.9190	20.0918	20.1392	20.1423	20.1422	20.1264	19.9498	19.6056	19.2984
Tweekend	19.6836	19.7487	19.8706	20.0159	20.1137	20.1406	20.1424	20.1423	20.1333	20.0334	19.8384	19.6644
MIT 2	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424	20.1424 (90)
Living area fraction									fLA = Living area / (4) =			0.2127 (91)
MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249	20.3249 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9898	0.9833	0.9636	0.8994	0.7381	0.4807	0.2952	0.3197	0.6346	0.9034	0.9775	0.9917 (94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Useful gains	829.8367	879.6634	910.9750	899.0720	752.4746	489.1618	285.9710	296.7604	561.2270	755.2695	787.8101	795.7648 (95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W												
Month fracti	1659.8259	1594.4135	1409.0783	1136.5266	809.4645	493.3045	286.1652	297.0673	580.5211	962.0935	1343.6659	1659.8259 (97)
Space heating kWh	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	617.5119	480.3121	370.5889	170.9673	42.4005	0.0000	0.0000	0.0000	0.0000	153.8771	400.2161	642.8614 (98)
Space heating per m2											(98) / (4) =	24.5458 (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 %)												230.5537 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1248.6183 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	617.5119	480.3121	370.5889	170.9673	42.4005	0.0000	0.0000	0.0000	0.0000	153.8771	400.2161	642.8614 (98)
Space heating efficiency (main heating system 1)	230.5537	230.5537	230.5537	230.5537	230.5537	0.0000	0.0000	0.0000	0.0000	230.5537	230.5537	230.5537 (210)
Space heating fuel (main heating system)	267.8387	208.3298	160.7387	74.1551	18.3907	0.0000	0.0000	0.0000	0.0000	66.7424	173.5892	278.8337 (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 requirement	206.2920	181.5692	190.0814	169.5545	165.5489	147.0491	140.3926	155.2016	155.2871	175.8594	187.0106	201.0450 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	109.1752	96.0912	100.5961	89.7327	87.6129	77.8223	74.2995	82.1368	82.1820	93.0695	98.9709	106.3984 (219)
Water heating fuel used												1098.0875 (219)
Annual totals kWh/year												1248.6183 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												77.8116 (230a)
Total electricity for the above, kWh/year												77.8116 (231)
Electricity for lighting (calculated in Appendix L)												483.8319 (232)
Total delivered energy for all uses												2908.3494 (238)

10a. Fuel costs - using BEDF prices (436)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1248.6183	10.0200	125.1116 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1098.0875	10.0200	110.0284 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	483.8319	16.9600	82.0579 (250)
Additional standing charges			30.0000 (251)
Total energy cost			347.1978 (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	1248.6183	0.5190	648.0329 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1098.0875	0.5190	569.9074 (264)
Space and water heating			1217.9404 (265)
Pumps and fans	77.8116	0.5190	40.3842 (267)
Energy for lighting	483.8319	0.5190	251.1087 (268)
Total kg/year			1509.4333 (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	1248.6183	3.0700	3833.2583 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	1098.0875	3.0700	3371.1288 (264)
Space and water heating			7204.3870 (265)
Pumps and fans	77.8116	3.0700	238.8817 (267)
Energy for lighting	483.8319	3.0700	1485.3638 (268)
Primary energy kWh/year			8928.6326 (272)
Primary energy kWh/m2/year			76.1309 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

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

(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: (none) SAP change Cost change CO2 change

Recommended measures (none) Typical annual savings Energy efficiency Environmental impact

Total Savings £0 0.00 kg/m²

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

Fuel prices for cost data on this page from database revision number 436 TEST (13 Dec 2018)
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	£347	£347	£0
Space heating	£155	£155	£0
Water heating	£110	£110	£0
Lighting	£82	£82	£0
Total cost of fuels	£347	£347	£0
Total cost of uses	£347	£347	£0
Delivered energy	25 kWh/m²	25 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.5 tonnes	1.5 tonnes	0.0 tonnes
CO2 emissions per m²	13 kg/m²	13 kg/m²	0 kg/m²
Primary energy	76 kWh/m²	76 kWh/m²	0 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

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	West
Overshading	Average or unknown
Thermal mass parameter	235.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	761.90 (P1)
Transmission heat loss coefficient	61.40 (37)
Summer heat loss coefficient	823.30 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North	0.000	1.000	None
South	0.000	1.000	None

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North	1.000	0.90	1.000	0.900 (P8)
South	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
North	10.3900	81.1852	0.6300	0.7000	0.9000	301.3116
South	4.8100	112.2060	0.6300	0.7000	0.9000	192.7901
total:						494.1017

	Jun	Jul	Aug	
Solar gains	526	494	435	(P3)
Internal gains	562	540	550	
Total summer gains	1088	1034	985	(P5)
Summer gain/loss ratio	1.32	1.26	1.20	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 235.7)	0.35	0.35	0.35	
Threshold temperature	17.67	19.51	19.35	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	21DES_BS_41			Issued on Date	10/05/2021
Assessment Reference	Be Green (ASHP + PV)	Prop Type Ref	2B3P, Top Flr		
Property	Plot '41', 86 Broad Street, Reading, Berkshire, RG1 2AP				
SAP Rating	88 B	DER	18.38	TER	24.49
Environmental	85 B	% DER<TER	24.93		
CO ₂ Emissions (t/year)	1.36	DFEE	46.05	TFEE	48.57
General Requirements Compliance	Pass	% DFEE<TFEE	5.18		
Assessor Details	Mr. Fulvio Vacca, Fulvio Vacca, Tel: 01924368145, softwaremanager@pellfrischmann.com			Assessor ID	W966-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 89 m²

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

1a TER and DER

Fuel for main heating:Electricity

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 24.49 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 18.38 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)48.6 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)46.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.080

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric

Mitsubishi ECODAN 8.5kW PUH2-W85VHA(2)-BS

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.00 kWh/day	
Permitted by DBSCG 2.03	OK	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Programmer, TRVs and bypass	OK
-------------------------	-----------------------------	----

Hot water controls:

Cylinderstat	OK
Independent timer for DHW	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system	
Specific fan power:	0.16
Maximum	0.7 OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
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Based on:

Overshading:	Average
Windows facing East:	6.77 m ² , No overhang
Windows facing South:	14.30 m ² , No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

10 Key features

Party wall U-value	0.00 W/m ² K
Air permeability	3.0 m ³ /m ² h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (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) =				0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door to Corridor			2.1200	1.2000	2.5440		(26)
Windows & Glazed Doors (Uw = 1.40)			21.0700	1.3258	27.9337		(27)
External Wall	82.7400	21.0700	61.6700	0.1800	11.1006	110.0000	6783.7000 (29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1705	2.4073	110.0000	1553.2000 (29a)
External Flat Roof	88.8300		88.8300	0.1600	14.2128	9.0000	799.4700 (30)
Total net area of external elements Aum(A, m ²)			187.8100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	58.1984	(33)
Party Wall with Flat			5.5000	0.0000	0.0000	20.0000	110.0000 (32)
Party Floor			88.8300			80.0000	7106.4000 (32d)
Internal Walls			195.8600			9.0000	1762.7400 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18115.5100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							203.9346 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							15.0248 (36)
Total fabric heat loss					(33) + (36) =		73.2232 (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	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615 (38)
Heat transfer coeff	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847 (39)
Average = Sum(39)m / 12 =												111.1847 (39)
HLP	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517 (40)
HLP (average)												1.2517 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5325	20.5816	21.2384	18.5162	17.7667	15.3313	14.2067	16.3024	16.4971	19.2258	20.9864	22.7899 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Heat gains from water heating, kWh/month	84.1655	74.5276	79.0804	72.0137	71.3847	64.9540	63.4934	68.1389	67.5382	74.6191	77.4896	82.5196 (65)
Total per year (kWh/year) = Sum(64)m =												1984.1626 (64)

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	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1206	18.7591	15.2559	11.5497	8.6336	7.2888	7.8758	10.2373	13.7405	17.4467	20.3628	21.7076 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.9087	239.3671	233.1721	219.9836	203.3355	187.6887	177.2357	174.7773	180.9723	194.1608	210.8088	226.4557 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468 (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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746 (71)
Water heating gains (Table 5)	113.1257	110.9041	106.2908	100.0191	95.9472	90.2139	85.3407	91.5846	93.8030	100.2945	107.6244	110.9134 (72)
Total internal gains	433.2954	431.1708	416.8593	393.6929	370.0568	347.3319	332.5926	338.7396	350.6563	374.0424	400.9365	421.2171 (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					6.7700	19.6403	0.6300	0.7000			0.7700	40.6357 (76)
South					14.3000	46.7521	0.6300	0.7000			0.7700	204.3190 (78)

Solar gains	244.9547	414.1139	557.1609	672.6812	736.0060	722.6524	700.0823	654.3013	597.5234	455.2450	292.8556	209.9672 (83)
Total gains	678.2501	845.2846	974.0202	1066.3741	1106.0628	1069.9843	1032.6749	993.0409	948.1797	829.2874	693.7921	631.1843 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588
alpha	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173
util living area	0.9888	0.9735	0.9432	0.8816	0.7729	0.6154	0.4610	0.4970	0.7083	0.9083	0.9775	0.9915 (86)
Tweekday	18.4085	18.7060	19.0726	19.4456	19.7162	19.8444	19.8739	19.8714	19.8090	19.4586	18.8454	18.3319
Tweekend	20.0712	20.2426	20.4570	20.6827	20.8597	20.9584	20.9897	20.9860	20.9252	20.6844	20.3209	20.0274
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (88)
util rest of house	0.9858	0.9666	0.9285	0.8508	0.7157	0.5252	0.3495	0.3841	0.6243	0.8774	0.9705	0.9892 (89)
Tweekday	18.4085	18.7060	19.0726	19.4456	19.7162	19.8444	19.8739	19.8714	19.8090	19.4586	18.8454	18.3319
Tweekend	19.0461	19.2146	19.4222	19.6335	19.7867	19.8593	19.8761	19.8747	19.8393	19.6408	19.2936	19.0027
MIT 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (90)
Living area fraction									fLA = Living area / (4) =			0.3296 (91)
MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9869	0.9691	0.9338	0.8618	0.7359	0.5563	0.3872	0.4224	0.6539	0.8887	0.9730	0.9900 (94)
Useful gains	669.3612	819.1445	909.4921	919.0197	813.9353	595.2525	399.8257	419.4908	620.0512	737.0083	675.0923	624.8768 (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	1773.2215	1706.5107	1528.6152	1261.7720	950.4548	628.0193	405.6499	427.8868	683.6116	1072.7580	1461.9044	1784.3400 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fraction	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	821.2721	596.3101	460.6276	246.7817	101.5705	0.0000	0.0000	0.0000	0.0000	249.7978	566.5047	862.6406 (98)
Space heating												3905.5051 (98)
Space heating per m2										(98) / (4) =		43.9661 (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 %)												234.6163 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1664.6351 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	821.2721	596.3101	460.6276	246.7817	101.5705	0.0000	0.0000	0.0000	0.0000	249.7978	566.5047	862.6406 (98)
Space heating efficiency (main heating system 1)	234.6163	234.6163	234.6163	234.6163	234.6163	0.0000	0.0000	0.0000	0.0000	234.6163	234.6163	234.6163 (210)
Space heating fuel (main heating system)	350.0490	254.1640	196.3323	105.1852	43.2922	0.0000	0.0000	0.0000	0.0000	106.4708	241.4601	367.6815 (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	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
Fuel for water heating, kWh/month	104.1970	91.7372	96.1032	85.8157	83.8544	74.5790	71.2941	78.6881	78.6921	89.0023	94.5313	101.5772 (219)
Water heating fuel used												1050.0715 (219)
Annual totals kWh/year												
Space heating fuel - main system												1664.6351 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV Centralised, Database: in-use factor = 1.3000, SFP = 0.2080)												
mechanical ventilation fans (SFP = 0.2080)												58.3825 (230a)
Total electricity for the above, kWh/year												58.3825 (231)
Electricity for lighting (calculated in Appendix L)												372.9961 (232)
Total delivered energy for all uses												3146.0851 (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	1664.6351	0.5190	863.9456 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1050.0715	0.5190	544.9871 (264)
Space and water heating			1408.9327 (265)
Pumps and fans	58.3825	0.5190	30.3005 (267)
Energy for lighting	372.9961	0.5190	193.5850 (268)
Total CO2, kg/year			1632.8182 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.3800 (273)

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

DER		18.3800 ZC1
Total Floor Area	TFA	88.8300
Assumed number of occupants	N	2.6094
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		15.8040 ZC2
CO2 emissions from cooking, equation (L16)		2.0446 ZC3
Total CO2 emissions		36.2287 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		36.2287 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) = 0.1304 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3804 (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) =				0.3519 (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	0.4486	0.4398	0.4310	0.3871	0.3783	0.3343	0.3343	0.3255	0.3519	0.3783	0.3958	0.4134 (22b)
Effective ac	0.6006	0.5967	0.5929	0.5749	0.5715	0.5559	0.5559	0.5530	0.5619	0.5715	0.5783	0.5855 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			20.0800	1.3258	26.6212		(27)
External Wall	82.7400	20.0800	62.6600	0.1800	11.2788		(29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1800	2.5416		(29a)
External Flat Roof	88.8300		88.8300	0.1300	11.5479		(30)
Total net area of external elements Aum(A, m ²)			187.8100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.1095		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.6989 (36)
Total fabric heat loss						(33) + (36) =	62.8084 (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	45.6019	45.3052	45.0144	43.6485	43.3929	42.2032	42.2032	41.9829	42.6615	43.3929	43.9099	44.4504 (38)
Heat transfer coeff	108.4103	108.1136	107.8228	106.4569	106.2013	105.0117	105.0117	104.7913	105.4699	106.2013	106.7183	107.2588 (39)
Average = Sum(39)m / 12 =												106.4557 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2204	1.2171	1.2138	1.1984	1.1956	1.1822	1.1822	1.1797	1.1873	1.1956	1.2014	1.2075 (40)
HLP (average)												1.1984 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (45)
Distribution loss (46)m = 0.15 x (45)m	23.5325	20.5816	21.2384	18.5162	17.7667	15.3313	14.2067	16.3024	16.4971	19.2258	20.9864	22.7899 (46)
Water storage loss:												170.0000 (47)
Store volume												1.5003 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8102 (55)
Enter (49) or (54) in (55)												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	205.2607	180.9069	189.9670	170.2581	166.8223	149.0258	143.0891	157.0604	156.7978	176.5496	186.7268	200.3105 (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)
Output from w/h	205.2607	180.9069	189.9670	170.2581	166.8223	149.0258	143.0891	157.0604	156.7978	176.5496	186.7268	200.3105 (64)
Heat gains from water heating, kWh/month	90.8658	80.5794	85.7806	78.4978	78.0850	71.4381	70.1937	74.8392	74.0223	81.3193	83.9737	89.2198 (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	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1167	18.7557	15.2532	11.5476	8.6320	7.2875	7.8744	10.2354	13.7380	17.4435	20.3591	21.7036 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.9087	239.3671	233.1721	219.9836	203.3355	187.6887	177.2357	174.7773	180.9723	194.1608	210.8088	226.4557 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468 (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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746 (71)
Water heating gains (Table 5)	122.1314	119.9098	115.2965	109.0248	104.9529	99.2196	94.3464	100.5903	102.8087	109.3002	116.6301	119.9191 (72)
Total internal gains	445.2973	443.1731	428.8622	405.6965	382.0609	359.3362	344.5969	350.7435	362.6595	386.0449	412.9385	433.2189 (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					6.4500	19.6403	0.6300	0.7000			0.7700	38.7150 (76)
South					13.6300	46.7521	0.6300	0.7000			0.7700	194.7460 (78)

Solar gains	233.4609	394.6784	531.0020	641.0849	701.4248	688.6946	667.1868	623.5641	569.4645	433.8763	279.1134	200.1157 (83)
Total gains	678.7582	837.8515	959.8642	1046.7813	1083.4858	1048.0309	1011.7837	974.3075	932.1240	819.9212	692.0519	633.3346 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.9019	57.0580	57.2119	57.9460	58.0854	58.7435	58.7435	58.8670	58.4882	58.0854	57.8040	57.5127
alpha	4.7935	4.8039	4.8141	4.8631	4.8724	4.9162	4.9162	4.9245	4.8992	4.8724	4.8536	4.8342
util living area	0.9943	0.9843	0.9608	0.9029	0.7892	0.6134	0.4514	0.4868	0.7144	0.9270	0.9867	0.9959 (86)
MIT	19.8146	20.0433	20.3299	20.6406	20.8609	20.9693	20.9943	20.9919	20.9351	20.6388	20.1614	19.7745 (87)
Th 2	19.9037	19.9064	19.9090	19.9213	19.9236	19.9343	19.9343	19.9363	19.9302	19.9236	19.9189	19.9140 (88)
util rest of house	0.9924	0.9793	0.9485	0.8731	0.7299	0.5228	0.3448	0.3783	0.6277	0.8976	0.9816	0.9945 (89)
MIT 2	18.3473	18.6797	19.0894	19.5231	19.7968	19.9154	19.9324	19.9332	19.8843	19.5332	18.8623	18.2963 (90)
Living area fraction									fLA = Living area / (4) =			0.3296 (91)
MIT	18.8310	19.1292	19.4983	19.8915	20.1476	20.2628	20.2824	20.2822	20.2306	19.8976	19.2905	18.7836 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8310	19.1292	19.4983	19.8915	20.1476	20.2628	20.2824	20.2822	20.2306	19.8976	19.2905	18.7836 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9899	0.9747	0.9427	0.8721	0.7433	0.5517	0.3801	0.4142	0.6536	0.8968	0.9776	0.9924 (94)
Useful gains	671.8794	816.6297	904.8761	912.9230	805.3072	578.2156	384.5786	403.5890	609.2761	735.2840	676.5327	628.5455 (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	1575.3077	1538.3654	1401.5147	1170.1160	897.1451	594.6552	386.6974	406.8198	646.5988	987.4188	1300.9530	1564.2160 (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	672.1506	485.0064	369.4991	185.1790	68.3274	0.0000	0.0000	0.0000	0.0000	187.5883	449.5826	696.1388 (98)
Space heating												3113.4722 (98)
Space heating per m2										(98) / (4) =		35.0498 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3329.9168 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	672.1506	485.0064	369.4991	185.1790	68.3274	0.0000	0.0000	0.0000	0.0000	187.5883	449.5826	696.1388	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	718.8777	518.7234	395.1862	198.0524	73.0774	0.0000	0.0000	0.0000	0.0000	200.6292	480.8370	744.5335	(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 requirement	205.2607	180.9069	189.9670	170.2581	166.8223	149.0258	143.0891	157.0604	156.7978	176.5496	186.7268	200.3105	(64)
Efficiency of water heater (217)m	87.7476	87.3193	86.5591	85.0381	82.6390	79.8000	79.8000	79.8000	79.8000	84.9757	87.0738	79.8000	(216)
Fuel for water heating, kWh/month	233.9218	207.1787	219.4652	200.2138	201.8686	186.7491	179.3096	196.8175	196.4885	207.7648	214.4465	227.9691	(219)
Water heating fuel used												2472.1933	(219)
Annual totals kWh/year													
Space heating fuel - main system												3329.9168	(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)												372.9280	(232)
Total delivered energy for all uses												6250.0380	(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	3329.9168	0.2160	719.2620 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2472.1933	0.2160	533.9937 (264)
Space and water heating			1253.2558 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	372.9280	0.5190	193.5496 (268)
Total CO2, kg/m2/year			1485.7304 (272)
Emissions per m2 for space and water heating			14.1085 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.1789 (272b)
Emissions per m2 for pumps and fans			0.4382 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1085 * 1.55) + 2.1789 + 0.4382, rounded to 2 d.p.			24.4900 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				Air changes per hour
Pressure test					30.0000 / (5) = 0.1304 (8)
Measured/design AP50					Yes
Infiltration rate					3.0000
Number of sides sheltered					0.2804 (18)
					1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2594 (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	0.3307	0.3242	0.3177	0.2853	0.2788	0.2464	0.2464	0.2399	0.2594	0.2788	0.2918	0.3048 (22b)
Effective ac	0.5547	0.5526	0.5505	0.5407	0.5389	0.5304	0.5304	0.5288	0.5336	0.5389	0.5426	0.5464 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door to Corridor			2.1200	1.2000	2.5440		(26)
Windows & Glazed Doors (Uw = 1.40)			21.0700	1.3258	27.9337		(27)
External Wall	82.7400	21.0700	61.6700	0.1800	11.1006	110.0000	6783.7000 (29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1705	2.4073	110.0000	1553.2000 (29a)
External Flat Roof	88.8300		88.8300	0.1600	14.2128	9.0000	799.4700 (30)
Total net area of external elements Aum(A, m ²)			187.8100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.1984		(33)
Party Wall with Flat			5.5000	0.0000	0.0000	20.0000	110.0000 (32)
Party Floor			88.8300			80.0000	7106.4000 (32d)
Internal Walls			195.8600			9.0000	1762.7400 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18115.5100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							203.9346 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							15.0248 (36)
Total fabric heat loss						(33) + (36) =	73.2232 (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	42.1128	41.9516	41.7936	41.0515	40.9126	40.2662	40.2662	40.1465	40.5152	40.9126	41.1935	41.4872 (38)
Heat transfer coeff	115.3360	115.1748	115.0168	114.2747	114.1358	113.4894	113.4894	113.3697	113.7384	114.1358	114.4167	114.7104 (39)
Average = Sum(39)m / 12 =												114.2740 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2984	1.2966	1.2948	1.2864	1.2849	1.2776	1.2776	1.2763	1.2804	1.2849	1.2880	1.2913 (40)
HLP (average)												1.2864 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)										Total = Sum(45)m =		1513.1666 (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:												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
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	33.3376	29.1573	30.0877	26.2312	25.1695	21.7193	20.1262	23.0951	23.3709	27.2365	29.7308	32.2857 (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	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1206	18.7591	15.2559	11.5497	8.6336	7.2888	7.8758	10.2373	13.7405	17.4467	20.3628	21.7076	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.9087	239.3671	233.1721	219.9836	203.3355	187.6887	177.2357	174.7773	180.9723	194.1608	210.8088	226.4557	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	(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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	(71)
Water heating gains (Table 5)	44.8087	43.3889	40.4405	36.4322	33.8299	30.1658	27.0513	31.0418	32.4596	36.6082	41.2928	43.3948	(72)
Total internal gains	364.9784	363.6555	351.0090	330.1060	307.9395	287.2838	274.3033	278.1968	289.3128	310.3562	334.6049	353.6985	(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					6.7700	19.6403	0.6300	0.7000			0.7700	40.6357 (76)	
South					14.3000	46.7521	0.6300	0.7000			0.7700	204.3190 (78)	

Solar gains	244.9547	414.1139	557.1609	672.6812	736.0060	722.6524	700.0823	654.3013	597.5234	455.2450	292.8556	209.9672 (83)	
Total gains	609.9331	777.7694	908.1699	1002.7872	1043.9455	1009.9361	974.3856	932.4981	886.8362	765.6012	627.4605	563.6657 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.6298	43.6908	43.7509	44.0350	44.0886	44.3397	44.3397	44.3865	44.2426	44.0886	43.9803	43.8678	
alpha	3.9087	3.9127	3.9167	3.9357	3.9392	3.9560	3.9560	3.9591	3.9495	3.9392	3.9320	3.9245	
util living area	0.9923	0.9803	0.9556	0.9024	0.8041	0.6511	0.4941	0.5331	0.7465	0.9287	0.9842	0.9943	(86)
MIT	19.4155	19.6898	20.0398	20.4254	20.7329	20.9171	20.9784	20.9706	20.8522	20.4274	19.8305	19.3582	(87)
Th 2	19.8421	19.8435	19.8449	19.8515	19.8527	19.8584	19.8584	19.8595	19.8562	19.8527	19.8502	19.8476	(88)
util rest of house	0.9902	0.9750	0.9434	0.8750	0.7493	0.5583	0.3744	0.4126	0.6633	0.9027	0.9790	0.9927	(89)
MIT 2	18.4163	18.6881	19.0309	19.4017	19.6743	19.8188	19.8524	19.8505	19.7762	19.4136	18.8350	18.3635	(90)
Living area fraction									fLA = Living area / (4) =			0.3296	(91)
MIT	18.7457	19.0183	19.3634	19.7392	20.0233	20.1808	20.2235	20.2197	20.1308	19.7478	19.1631	18.6914	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7457	19.0183	19.3634	19.7392	20.0233	20.1808	20.2235	20.2197	20.1308	19.7478	19.1631	18.6914	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	602.2658	754.4985	851.1389	874.3609	791.6332	591.7989	403.2896	421.6534	607.6401	688.8624	611.7168	558.2957	(94)
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	1666.1039	1626.0728	1479.5123	1238.6407	949.9826	633.3647	411.2326	433.0375	685.9377	1044.0919	1380.2210	1662.3110	(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	791.4956	585.6979	467.5098	262.2814	117.8120	0.0000	0.0000	0.0000	0.0000	264.2907	553.3231	821.3874	(98)
Space heating												3863.7979	(98)
Space heating per m2												43.4965	(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	1066.8003	839.8215	861.6096	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8634	0.9183	0.9033	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	921.0971	771.2295	778.2615	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1278.6317	1235.0026	1187.7172	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													

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Calculation Type: New Build (As Designed)

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	0.0000	0.0000	0.0000	0.0000	0.0000	257.4249	345.0472	304.6350	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												907.1072 (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	64.3562	86.2618	76.1588	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												226.7768 (107)
Space cooling per m2												2.5529 (108)
Energy for space heating												43.4965 (99)
Energy for space cooling												2.5529 (108)
Total												46.0495 (109)
Dwelling Fabric Energy Efficiency (DFEE)												46.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1304 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3804 (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) = 0.3519 (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												
Effective ac	0.4486	0.4398	0.4310	0.3871	0.3783	0.3343	0.3343	0.3255	0.3519	0.3783	0.3958	0.4134 (22b)
	0.6006	0.5967	0.5929	0.5749	0.5715	0.5559	0.5559	0.5530	0.5619	0.5715	0.5783	0.5855 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			20.0800	1.3258	26.6212		(27)
External Wall	82.7400	20.0800	62.6600	0.1800	11.2788		(29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1800	2.5416		(29a)
External Flat Roof	88.8300		88.8300	0.1300	11.5479		(30)
Total net area of external elements Aum(A, m ²)			187.8100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 54.1095		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.6989 (36)
Total fabric heat loss							(33) + (36) = 62.8084 (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	45.6019	45.3052	45.0144	43.6485	43.3929	42.2032	42.2032	41.9829	42.6615	43.3929	43.9099	44.4504 (38)
Heat transfer coeff	108.4103	108.1136	107.8228	106.4569	106.2013	105.0117	105.0117	104.7913	105.4699	106.2013	106.7183	107.2588 (39)
Average = Sum(39)m / 12 =												106.4557 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2204	1.2171	1.2138	1.1984	1.1956	1.1822	1.1822	1.1797	1.1873	1.1956	1.2014	1.2075 (40)
HLP (average)												1.1984 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (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	33.3376	29.1573	30.0877	26.2312	25.1695	21.7193	20.1262	23.0951	23.3709	27.2365	29.7308	32.2857 (65)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682	130.4682 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.1167	18.7557	15.2532	11.5476	8.6320	7.2875	7.8744	10.2354	13.7380	17.4435	20.3591	21.7036 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.9087	239.3671	233.1721	219.9836	203.3355	187.6887	177.2357	174.7773	180.9723	194.1608	210.8088	226.4557 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468	36.0468 (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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746 (71)
Water heating gains (Table 5)	44.8087	43.3889	40.4405	36.4322	33.8299	30.1658	27.0513	31.0418	32.4596	36.6082	41.2928	43.3948 (72)
Total internal gains	364.9745	363.6521	351.0062	330.1039	307.9379	287.2824	274.3018	278.1950	289.3103	310.3530	334.6012	353.6945 (73)

[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				6.4500	19.6403		0.6300		0.7000		0.7700		38.7150 (76)
South				13.6300	46.7521		0.6300		0.7000		0.7700		194.7460 (78)
Solar gains	233.4609	394.6784	531.0020	641.0849	701.4248	688.6946	667.1868	623.5641	569.4645	433.8763	279.1134	200.1157	(83)
Total gains	598.4355	758.3305	882.0081	971.1888	1009.3628	975.9771	941.4886	901.7590	858.7748	744.2293	613.7146	553.8103	(84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{li,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.9019	57.0580	57.2119	57.9460	58.0854	58.7435	58.7435	58.8670	58.4882	58.0854	57.8040	57.5127
alpha	4.7935	4.8039	4.8141	4.8631	4.8724	4.9162	4.9162	4.9245	4.8992	4.8724	4.8536	4.8342
util living area	0.9967	0.9895	0.9713	0.9230	0.8206	0.6501	0.4831	0.5229	0.7553	0.9471	0.9919	0.9977 (86)
MIT	19.7327	19.9657	20.2614	20.5895	20.8328	20.9605	20.9924	20.9889	20.9169	20.5810	20.0838	19.6927 (87)
Th 2	19.9037	19.9064	19.9090	19.9213	19.9236	19.9343	19.9343	19.9363	19.9302	19.9236	19.9189	19.9140 (88)
util rest of house	0.9956	0.9860	0.9617	0.8975	0.7647	0.5574	0.3701	0.4079	0.6700	0.9240	0.9886	0.9969 (89)
MIT 2	18.7598	18.9928	19.2845	19.6051	19.8171	19.9173	19.9325	19.9334	19.8887	19.6064	19.1215	18.7282 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.3296 (91)
MIT	19.0805	19.3135	19.6065	19.9296	20.1519	20.2612	20.2819	20.2813	20.2276	19.9276	19.4387	19.0461 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0805	19.3135	19.6065	19.9296	20.1519	20.2612	20.2819	20.2813	20.2276	19.9276	19.4387	19.0461 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9944	0.9836	0.9585	0.8977	0.7777	0.5871	0.4076	0.4461	0.6957	0.9241	0.9867	0.9960 (94)
Useful gains	595.0855	745.9034	845.3721	871.8263	784.9335	573.0340	383.7568	402.2625	597.4224	687.7445	605.5623	551.6160 (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	1602.3586	1558.2928	1413.1761	1174.1722	897.6031	594.4874	386.6392	406.7287	646.2771	990.6056	1316.7657	1592.3768 (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	749.4112	545.9257	422.4462	217.6891	83.8261	0.0000	0.0000	0.0000	0.0000	225.3286	512.0664	774.3260 (98)
Space heating												3531.0193 (98)
Space heating per m2												39.7503 (99)
										(98) / (4) =		

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												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	987.1096	777.0862	796.4142	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9100	0.9545	0.9435	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	898.3014	741.7029	751.4192	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1238.9375	1196.5497	1151.7860	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	245.2580	338.4060	297.8729	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												881.5369 (104)
Intermittency factor (Table 10b)									fc = cooled area / (4) =			1.0000 (105)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	61.3145	84.6015	74.4682	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												220.3842 (107)
Energy for space heating												2.4810 (108)
Energy for space cooling												39.7503 (99)
Total												2.4810 (108)
Target Fabric Energy Efficiency (TFEE)												42.2313 (109)
												48.6 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (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) =				0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1492	0.1422	0.1422	0.1318	0.1353	0.1179	0.1179	0.1145	0.1179	0.1318	0.1283	0.1388 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door to Corridor			2.1200	1.2000	2.5440		(26)
Windows & Glazed Doors (Uw = 1.40)			21.0700	1.3258	27.9337		(27)
External Wall	82.7400	21.0700	61.6700	0.1800	11.1006	110.0000	6783.7000 (29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1705	2.4073	110.0000	1553.2000 (29a)
External Flat Roof	88.8300		88.8300	0.1600	14.2128	9.0000	799.4700 (30)
Total net area of external elements Aum(A, m ²)					187.8100		(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	58.1984	(33)
Party Wall with Flat				5.5000	0.0000	20.0000	110.0000 (32)
Party Floor				88.8300		80.0000	7106.4000 (32d)
Internal Walls				195.8600		9.0000	1762.7400 (32c)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (User defined value 0.080 * total exposed area)
Total fabric heat loss

(28)...(30) + (32) + (32a)...(32e) =	18115.5100 (34)
203.9346 (35)	
15.0248 (36)	
(33) + (36) =	73.2232 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	
(38)m	37.9615
Heat transfer coeff	111.1847
Average = Sum(39)m / 12 =	111.1847 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517 (40)
HLP (average)												1.2517 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5325	20.5816	21.2384	18.5162	17.7667	15.3313	14.2067	16.3024	16.4971	19.2258	20.9864	22.7899	(46)
Water storage loss:													
Store volume													170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.5400 (55)
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(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	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352	(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)
Output from w/h	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352	(64)
RHI water heating demand													1984.1626 (64)
Heat gains from water heating, kWh/month	84.1655	74.5276	79.0804	72.0137	71.3847	64.9540	63.4934	68.1389	67.5382	74.6191	77.4896	82.5196	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.8015	46.8978	38.1398	28.8743	21.5839	18.2220	19.6895	25.5932	34.3512	43.6167	50.9071	54.2690	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	353.5951	357.2643	348.0180	328.3337	303.4859	280.1324	264.5309	260.8617	270.1079	289.7922	314.6400	337.9935	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	(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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	(71)
Water heating gains (Table 5)	113.1257	110.9041	106.2908	100.0191	95.9472	90.2139	85.3407	91.5846	93.8030	100.2945	107.6244	110.9134	(72)
Total internal gains	624.9751	620.5190	597.9015	562.6800	526.4699	494.0212	475.0139	483.4923	503.7150	539.1562	578.6244	608.6288	(73)

6. Solar gains

[Jan]													
Area	6.7700												
Solar flux	23.8018												
Specific data	0.6300												
Specific data	0.7000												
Access factor	0.7700												
Gains W	49.2459												(76)
East	14.3000												(78)
South													
Solar gains	286.2091	422.2987	564.2736	694.6922	744.9055	776.0946	743.4013	708.6194	645.9041	498.1661	336.9353	246.8674	(83)
Total gains	911.1842	1042.8177	1162.1751	1257.3722	1271.3753	1270.1158	1218.4152	1192.1116	1149.6190	1037.3223	915.5596	855.4961	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
Jan	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	
Feb	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	
util living area	0.9649	0.9407	0.8903	0.7932	0.6455	0.4445	0.2994	0.3150	0.5510	0.8079	0.9349	0.9713	(86)
Tweekday	18.8115	19.0350	19.3500	19.6448	19.8161	19.8724	19.8785	19.8783	19.8591	19.6744	19.2127	18.7471	
Tweekend	20.3042	20.4361	20.6262	20.8145	20.9374	20.9893	20.9984	20.9980	20.9737	20.8291	20.5384	20.2664	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	(88)
util rest of house	0.9560	0.9264	0.8647	0.7477	0.5746	0.3534	0.1986	0.2122	0.4594	0.7555	0.9163	0.9638	(89)
Tweekday	18.8115	19.0350	19.3500	19.6448	19.8161	19.8724	19.8785	19.8783	19.8591	19.6744	19.2127	18.7471	
Tweekend	19.2743	19.4009	19.5794	19.7463	19.8433	19.8752	19.8787	19.8786	19.8677	19.7631	19.5016	19.2379	
MIT 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	(90)
Living area fraction									fLA = Living area / (4) =				0.3296 (91)
MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	(92)
Temperature adjustment													0.0000
adjusted MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	(93)

8. Space heating requirement

Utilisation	0.9592	0.9315	0.8738	0.7637	0.5990	0.3840	0.2320	0.2463	0.4906	0.7741	0.9230	0.9665	(94)
Useful gains	874.0325	971.4032	1015.5100	960.2198	761.5821	487.7046	282.7261	293.6587	564.0422	803.0306	845.0698	826.8445	(95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000	(96)
Heat loss rate W													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Month fracti	1684.2738	1617.5630	1428.5490	1150.5873	817.0332	494.5976	283.3467	294.4652	583.5454	972.6918	1361.8382	1684.2738	(97)
Space heating kWh	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	602.8195	434.2194	307.3010	137.0646	41.2556	0.0000	0.0000	0.0000	0.0000	126.2280	372.0732	637.9274	(98)
RHI space heating demand												2658.8887	(98)
												2659	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (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) =				0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door to Corridor			2.1200	1.2000	2.5440		(26)
Windows & Glazed Doors (Uw = 1.40)			21.0700	1.3258	27.9337		(27)
External Wall	82.7400	21.0700	61.6700	0.1800	11.1006	110.0000	6783.7000 (29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1705	2.4073	110.0000	1553.2000 (29a)
External Flat Roof	88.8300		88.8300	0.1600	14.2128	9.0000	799.4700 (30)
Total net area of external elements Aum(A, m ²)					187.8100		(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	58.1984	(33)
Party Wall with Flat				5.5000	0.0000	20.0000	110.0000 (32)
Party Floor				88.8300		80.0000	7106.4000 (32d)
Internal Walls				195.8600		9.0000	1762.7400 (32c)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (User defined value 0.080 * total exposed area)
Total fabric heat loss

(28)...(30) + (32) + (32a)...(32e) =	18115.5100 (34)
	203.9346 (35)
	15.0248 (36)
(33) + (36) =	73.2232 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	
(38)m	37.9615
Heat transfer coeff	111.1847
Average = Sum(39)m / 12 =	111.1847 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517 (40)
HLP (average)												1.2517 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	23.5325	20.5816	21.2384	18.5162	17.7667	15.3313	14.2067	16.3024	16.4971	19.2258	20.9864	22.7899 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Heat gains from water heating, kWh/month	84.1655	74.5276	79.0804	72.0137	71.3847	64.9540	63.4934	68.1389	67.5382	74.6191	77.4896	82.5196 (65)
Total per year (kWh/year) = Sum(64)m =												1984.1626 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.8015	46.8978	38.1398	28.8743	21.5839	18.2220	19.6895	25.5932	34.3512	43.6167	50.9071	54.2690 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	353.5951	357.2643	348.0180	328.3337	303.4859	280.1324	264.5309	260.8617	270.1079	289.7922	314.6400	337.9935 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656 (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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746 (71)
Water heating gains (Table 5)	113.1257	110.9041	106.2908	100.0191	95.9472	90.2139	85.3407	91.5846	93.8030	100.2945	107.6244	110.9134 (72)
Total internal gains	624.9751	620.5190	597.9015	562.6800	526.4699	494.0212	475.0139	483.4923	503.7150	539.1562	578.6244	608.6288 (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					6.7700	19.6403	0.6300	0.7000	0.7700		40.6357 (76)	
South					14.3000	46.7521	0.6300	0.7000	0.7700		204.3190 (78)	

Solar gains	244.9547	414.1139	557.1609	672.6812	736.0060	722.6524	700.0823	654.3013	597.5234	455.2450	292.8556	209.9672 (83)
Total gains	869.9297	1034.6329	1155.0624	1235.3612	1262.4758	1216.6735	1175.0962	1137.7936	1101.2384	994.4012	871.4800	818.5960 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588
alpha	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173
util living area	0.9741	0.9502	0.9086	0.8333	0.7140	0.5547	0.4090	0.4394	0.6375	0.8561	0.9537	0.9792 (86)
Tweekday	18.6480	18.9187	19.2395	19.5505	19.7623	19.8558	19.8757	19.8742	19.8334	19.5732	19.0479	18.5710
Tweekend	20.2096	20.3681	20.5593	20.7526	20.8961	20.9712	20.9933	20.9910	20.9490	20.7612	20.4407	20.1650
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (88)
util rest of house	0.9677	0.9384	0.8875	0.7959	0.6535	0.4687	0.3083	0.3370	0.5535	0.8151	0.9406	0.9740 (89)
Tweekday	18.6480	18.9187	19.2395	19.5505	19.7623	19.8558	19.8757	19.8742	19.8334	19.5732	19.0479	18.5710
Tweekend	19.1817	19.3350	19.5168	19.6929	19.8129	19.8658	19.8771	19.8763	19.8531	19.7058	19.4082	19.1382
MIT 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (90)
Living area fraction									fLA = Living area / (4) =			0.3296 (91)
MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (93)

8. Space heating requirement

Utilisation	0.9700	0.9426	0.8950	0.8091	0.6745	0.4980	0.3420	0.3714	0.5826	0.8298	0.9454	0.9759 (94)
Useful gains	843.8404	975.2429	1033.7432	999.4877	851.5618	605.8921	401.9286	422.5972	641.5878	825.1944	823.8745	798.8363 (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	1773.2215	1706.5107	1528.6152	1261.7720	950.4548	628.0193	405.6499	427.8868	683.6116	1072.7580	1461.9044	1784.3400 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fraction	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	691.4596	491.4120	368.1848	188.8447	73.5764	0.0000	0.0000	0.0000	0.0000	184.1873	459.3815	733.2147 (98)
Space heating												3190.2610 (98)
Space heating per m2											(98) / (4) =	35.9142 (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 %)												234.6163 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1359.7781 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	691.4596	491.4120	368.1848	188.8447	73.5764	0.0000	0.0000	0.0000	0.0000	184.1873	459.3815	733.2147 (98)
Space heating efficiency (main heating system 1)	234.6163	234.6163	234.6163	234.6163	234.6163	0.0000	0.0000	0.0000	0.0000	234.6163	234.6163	234.6163 (210)
Space heating fuel (main heating system)	294.7193	209.4535	156.9306	80.4909	31.3603	0.0000	0.0000	0.0000	0.0000	78.5058	195.8012	312.5165 (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	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Efficiency of water heater	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
(217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (217)
Fuel for water heating, kWh/month	104.1970	91.7372	96.1032	85.8157	83.8544	74.5790	71.2941	78.6881	78.6921	89.0023	94.5313	101.5772 (219)
Water heating fuel used												1050.0715 (219)
Annual totals kWh/year												
Space heating fuel - main system												1359.7781 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2080)												
mechanical ventilation fans (SFP = 0.2080)												58.3825 (230a)
Total electricity for the above, kWh/year												58.3825 (231)
Electricity for lighting (calculated in Appendix L)												372.9961 (232)
Total delivered energy for all uses												2841.2282 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1359.7781	6.6100	89.8813 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1050.0715	6.6100	69.4097 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	372.9961	13.1900	49.1982 (250)
Additional standing charges			70.0000 (251)
Total energy cost			278.4892 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.8740 (257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	87.8079
SAP rating (Section 12)		88 (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	1359.7781	0.5190	705.7248 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1050.0715	0.5190	544.9871 (264)
Space and water heating			1250.7119 (265)
Pumps and fans	58.3825	0.5190	30.3005 (267)
Energy for lighting	372.9961	0.5190	193.5850 (268)
Total kg/year			1474.5974 (272)
CO2 emissions per m2			16.6000 (273)
EI value			85.2353
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	$6.61 \times (1 + 0.29 \times 0.00) / 2.3462 = 2.817$, stars = 5
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 2.3462 = 0.2212$, stars = 4
Water heating energy efficiency	$6.61 / 1.8896 = 3.498$, stars = 5
Water heating environmental impact	$0.519 / 1.8896 = 0.2747$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	88.8300 (1b)	x 2.5900 (2b)	= 230.0697 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.8300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 230.0697 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.1500 (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) =				0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000 (22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000 (22a)
Adj infilt rate	0.1492	0.1422	0.1422	0.1318	0.1353	0.1179	0.1179	0.1145	0.1179	0.1318	0.1283	0.1388 (22b)
Mechanical extract ventilation - centralised												0.5000 (23a)
If mechanical ventilation:												
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door to Corridor			2.1200	1.2000	2.5440		(26)
Windows & Glazed Doors (Uw = 1.40)			21.0700	1.3258	27.9337		(27)
External Wall	82.7400	21.0700	61.6700	0.1800	11.1006	110.0000	6783.7000 (29a)
Communal-facing Wall	16.2400	2.1200	14.1200	0.1705	2.4073	110.0000	1553.2000 (29a)
External Flat Roof	88.8300		88.8300	0.1600	14.2128	9.0000	799.4700 (30)
Total net area of external elements Aum(A, m ²)			187.8100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	58.1984	(33)
Party Wall with Flat			5.5000	0.0000	0.0000	20.0000	110.0000 (32)
Party Floor			88.8300			80.0000	7106.4000 (32d)
Internal Walls			195.8600			9.0000	1762.7400 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18115.5100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							203.9346 (35)
Thermal bridges (User defined value 0.080 * total exposed area)							15.0248 (36)
Total fabric heat loss					(33) + (36) =		73.2232 (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	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615	37.9615 (38)
Heat transfer coeff	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847	111.1847 (39)
Average = Sum(39)m / 12 =												111.1847 (39)
HLP	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517	1.2517 (40)
HLP (average)												1.2517 (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												2.6094 (42)
Average daily hot water use (litres/day)												96.1724 (43)
Daily hot water use	105.7897	101.9428	98.0959	94.2490	90.4021	86.5552	86.5552	90.4021	94.2490	98.0959	101.9428	105.7897 (44)
Energy conte	156.8830	137.2109	141.5893	123.4410	118.4446	102.2087	94.7114	108.6827	109.9807	128.1719	139.9096	151.9328 (45)
Energy content (annual)												Total = Sum(45)m = 1513.1666 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Distribution loss (46)m = 0.15 x (45)m	23.5325	20.5816	21.2384	18.5162	17.7667	15.3313	14.2067	16.3024	16.4971	19.2258	20.9864	22.7899 (46)
Water storage loss:												
Store volume												170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(56)
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400	(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	(59)
Total heat required for water heating calculated for each month												
196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Heat gains from water heating, kWh/month	84.1655	74.5276	79.0804	72.0137	71.3847	64.9540	63.4934	68.1389	67.5382	74.6191	77.4896	82.5196 (65)
Total per year (kWh/year) = Sum(64)m =												1984.1626 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619	156.5619 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.8015	46.8978	38.1398	28.8743	21.5839	18.2220	19.6895	25.5932	34.3512	43.6167	50.9071	54.2690 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	353.5951	357.2643	348.0180	328.3337	303.4859	280.1324	264.5309	260.8617	270.1079	289.7922	314.6400	337.9935 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656	53.2656 (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)	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746	-104.3746 (71)
Water heating gains (Table 5)	113.1257	110.9041	106.2908	100.0191	95.9472	90.2139	85.3407	91.5846	93.8030	100.2945	107.6244	110.9134 (72)
Total internal gains	624.9751	620.5190	597.9015	562.6800	526.4699	494.0212	475.0139	483.4923	503.7150	539.1562	578.6244	608.6288 (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					6.7700	23.8018		0.6300		0.7000	0.7700	49.2459 (76)
South					14.3000	54.2217		0.6300		0.7000	0.7700	236.9633 (78)
Solar gains	286.2091	422.2987	564.2736	694.6922	744.9055	776.0946	743.4013	708.6194	645.9041	498.1661	336.9353	246.8674 (83)
Total gains	911.1842	1042.8177	1162.1751	1257.3722	1271.3753	1270.1158	1218.4152	1192.1116	1149.6190	1037.3223	915.5596	855.4961 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588	45.2588
alpha	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173	4.0173
util living area	0.9649	0.9407	0.8903	0.7932	0.6455	0.4445	0.2994	0.3150	0.5510	0.8079	0.9349	0.9713 (86)
Tweekday	18.8115	19.0350	19.3500	19.6448	19.8161	19.8724	19.8785	19.8783	19.8591	19.6744	19.2127	18.7471
Tweekend	20.3042	20.4361	20.6262	20.8145	20.9374	20.9893	20.9984	20.9980	20.9737	20.8291	20.5384	20.2664
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000 (87)
Th 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (88)
util rest of house	0.9560	0.9264	0.8647	0.7477	0.5746	0.3534	0.1986	0.2122	0.4594	0.7555	0.9163	0.9638 (89)
Tweekday	18.8115	19.0350	19.3500	19.6448	19.8161	19.8724	19.8785	19.8783	19.8591	19.6744	19.2127	18.7471
Tweekend	19.2743	19.4009	19.5794	19.7463	19.8433	19.8752	19.8787	19.8786	19.8677	19.7631	19.5016	19.2379
MIT 2	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789	19.8789 (90)
Living area fraction									fLA = Living area / (4) =			0.3296 (91)
MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484	20.2484 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9592	0.9315	0.8738	0.7637	0.5990	0.3840	0.2320	0.2463	0.4906	0.7741	0.9230	0.9665 (94)
Useful gains	874.0325	971.4032	1015.5100	960.2198	761.5821	487.7046	282.7261	293.6587	564.0422	803.0306	845.0698	826.8445 (95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	1684.2738	1617.5630	1428.5490	1150.5873	817.0332	494.5976	283.3467	294.4652	583.5454	972.6918	1361.8382	1684.2738 (97)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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	602.8195	434.2194	307.3010	137.0646	41.2556	0.0000	0.0000	0.0000	0.0000	126.2280	372.0732	637.9274 (98)
Space heating												2658.8887 (98)
Space heating per m2											(98) / (4) =	29.9323 (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 %)												234.6163 (206)
Efficiency of secondary/supplementary heating system, %												100.0000 (208)
Space heating requirement												1133.2924 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	602.8195	434.2194	307.3010	137.0646	41.2556	0.0000	0.0000	0.0000	0.0000	126.2280	372.0732	637.9274 (98)
Space heating efficiency (main heating system 1)	234.6163	234.6163	234.6163	234.6163	234.6163	0.0000	0.0000	0.0000	0.0000	234.6163	234.6163	234.6163 (210)
Space heating fuel (main heating system)	256.9385	185.0764	130.9803	58.4208	17.5843	0.0000	0.0000	0.0000	0.0000	53.8019	158.5880	271.9024 (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 requirement	196.8854	173.3421	181.5917	162.1530	158.4470	140.9207	134.7138	148.6851	148.6927	168.1743	178.6216	191.9352 (64)
Efficiency of water heater (217)m	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550	188.9550 (216)
Fuel for water heating, kWh/month	104.1970	91.7372	96.1032	85.8157	83.8544	74.5790	71.2941	78.6881	78.6921	89.0023	94.5313	101.5772 (219)
Water heating fuel used												1050.0715 (219)
Annual totals kWh/year												
Space heating fuel - main system												1133.2924 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)												
mechanical ventilation fans (SFP = 0.2080)												58.3825 (230a)
Total electricity for the above, kWh/year												58.3825 (231)
Electricity for lighting (calculated in Appendix L)												372.9961 (232)
Total delivered energy for all uses												2614.7425 (238)

10a. Fuel costs - using BEDF prices (436)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1133.2924	10.0200	113.5559 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1050.0715	10.0200	105.2172 (247)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	372.9961	16.9600	63.2601 (250)
Additional standing charges			30.0000 (251)
Total energy cost			312.0332 (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	1133.2924	0.5190	588.1788 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	1050.0715	0.5190	544.9871 (264)
Space and water heating			1133.1659 (265)
Pumps and fans	58.3825	0.5190	30.3005 (267)
Energy for lighting	372.9961	0.5190	193.5850 (268)
Total kg/year			1357.0514 (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	1133.2924	3.0700	3479.2078 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	1050.0715	3.0700	3223.7194 (264)
Space and water heating			6702.9272 (265)
Pumps and fans	58.3825	3.0700	179.2342 (267)
Energy for lighting	372.9961	3.0700	1145.0980 (268)
Primary energy kWh/year			8027.2594 (272)
Primary energy kWh/m2/year			90.3665 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
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: (none) SAP change Cost change CO2 change

Recommended measures (none) Typical annual savings Energy efficiency Environmental impact

Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: B 88
Potential environmental impact rating: B 85

Fuel prices for cost data on this page from database revision number 436 TEST (13 Dec 2018)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current £312	Potential £312	Saving £0
Electricity			
Space heating	£144	£144	£0
Water heating	£105	£105	£0
Lighting	£63	£63	£0
Total cost of fuels	£312	£312	£0
Total cost of uses	£312	£312	£0
Delivered energy	29 kWh/m²	29 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.4 tonnes	1.4 tonnes	0.0 tonnes
CO2 emissions per m²	15 kg/m²	15 kg/m²	0 kg/m²
Primary energy	90 kWh/m²	90 kWh/m²	0 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	MidTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	203.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	455.54 (P1)
Transmission heat loss coefficient	73.22 (37)
Summer heat loss coefficient	528.76 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
East	1.000	0.90	1.000	0.900 (P8)
South	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	6.7700	117.5071	0.6300	0.7000	0.9000	284.1687
South	14.3000	112.2060	0.6300	0.7000	0.9000	573.1598
total:						857.3285

	Jun	Jul	Aug	
Solar gains	896	857	816	(P3)
Internal gains	494	475	483	
Total summer gains	1390	1332	1299	(P5)
Summer gain/loss ratio	2.63	2.52	2.46	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 203.9)	0.57	0.57	0.57	
Threshold temperature	19.20	20.99	20.83	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

12 BRUKL DATASHEET

Project name

Shell and Core

86-88 Broad Street Retail Unit

As designed

Administrative information

Building Details

Address: Reading,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Desco

Telephone number:

Address: 2, Azure Court, Sunderland, SR3 3BE

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	33.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	33.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	24.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.17	PR000008:Surf[3]
Floor	0.25	0.15	0.15	PR000002:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	1.4	1.4	PR000008:Surf[1]
Personnel doors	2.2	2.2	2.2	PR000009:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)]				
* There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the [Non-Domestic Building Services Compliance Guide](#) for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	4.2	0	0	0.8
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- VRF

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.5	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]										HR efficiency	
	ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
	Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
00_Retail		-	-	-	1.6	-	-	-	-	-	-	N/A
00_Resi Service corridor		-	-	-	1.6	-	-	-	-	-	-	N/A
00_Lobby		-	-	-	1.6	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
00_Retail Refure	NO
00_Retail	NO
00_Resi Service corridor	NO
00_Lobby	NO

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
	Standard value	60	60	22
00_Retail Refure	95	-	-	20

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
00_Retail		-	95	65	2978
00_Resi Service corridor		-	95	-	54
00_Lobby		-	95	-	21

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_Retail	NO (-28.2%)	NO
00_Resi Service corridor	N/A	N/A
00_Lobby	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	357.0	357.0
External area [m ²]	411.6	411.6
Weather	SWI	SWI
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	98.39	120.92
Average U-value [W/m ² K]	0.24	0.29
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	1.11	1.23
Cooling	4.25	7.42
Auxiliary	7.12	2.97
Lighting	34.67	54.54
Hot water	0.43	0.55
Equipment*	18.36	18.36
TOTAL**	47.58	66.7

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	78.3	112.47
Primary energy* [kWh/m ²]	146.06	199.66
Total emissions [kg/m ²]	24.7	33.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	14.7	67.7	1.2	4.5	7.5	3.5	4.2	3.5	4.2
Notional	11.9	106.5	1.3	7.8	3.1	2.56	3.79	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.17	PR000008:Surf[3]
Floor	0.2	0.15	PR000002:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	1.4	PR000008:Surf[1]
Personnel doors	1.5	2.2	PR000009:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

13 PART L DATA INPUT REPORT

Broad Street Reading - Retail

Part L Input Data Report

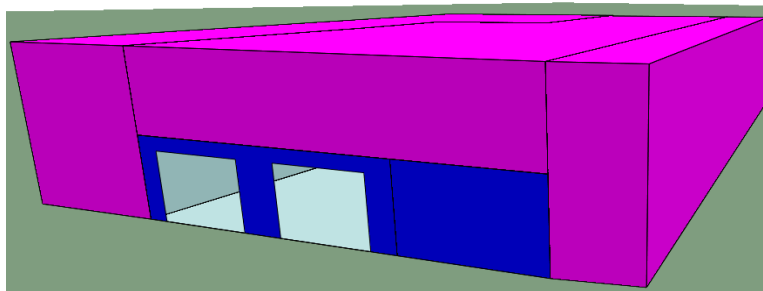


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Date	Created by	Checked by	Stage
07/05/2021	SL	KK	Planing

Contents

- 1) Part L Result
- 2) Constructions
- 3) System Input Heating
- 4) System Input Cooling
- 5) Room Level System Input
- 6) Room Level Lighting Input
- 7) Renewables





1.0 Part L Result

Model	Building CO ₂ emisison rate (BER) (kgCO ₂ /m ² per annum)	Target CO ₂ emisison rate (TER) (kgCO ₂ /m ² per annum)	Overall building energy performance ratio (EPRnc)	BREEAM 2018 Credits achieved
Retail Unit - Be Green	24.7	33.8	0.549	5
Retail Unit - Be Lean	32.7	39.5		

Energy Consumption by End Use	Actual (kWh/m ²)	Notional (kWh/m ²)
Retail Unit - Be Green		
Heating	1.11	1.23
Cooling	4.25	7.42
Auxiliary	7.12	2.97
Lighting	34.67	54.54
Hot Water	0.43	0.55
Equipment	18.36	18.36
TOTAL	65.94	85.07

Energy Production by Technology	Actual (kWh/m ²)	Notional (kWh/m ²)
Photovoltaic systems	-	-
Wind turbines	-	-
CHP generators	-	-
Solar thermal systems	-	-

2.0 Constructions

Construction	Actual U Value (W/m ² K)	2013 Building Regulations Notional U Value (W/m ² K)	2013 Building Regulations Limiting U Value (W/m ² K)	g-value (glass only EN-410)
External Wall	0.17	0.26	0.35	-
Opaque Curtain Wall	N/A	-	-	-
Roofs	N/A	0.18	0.25	-
Exposed Floors	0.15	0.22	0.25	-
External Glazing / Rooflights	1.40	1.60	2.20	0.40
Door	2.20	2.20	2.20	-

Air Permeability (m ³ /(h.m ²) @ 50 Pa	3.00	3.00	10.00
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3.0 System Input Heating

System Name	NCM Type	Heating Fuel	Delivery Eff.	SCoP kW/kW	Delivery Efficiency	SSEER (kW/kW)	Vent Heat Recovery Eff.	System Specific Fan Power (SFP W/(l/s))
VRF	Split or multi-split system	Electricity: Meter 1	1.0	3.5	1.0	3.5	0.8	0.0



4.0 System Input Cooling

System Name	NCM Type	Cooling Fuel	Delivery Efficiency	Nominal EER* (kW/kW)	Seasonal EER* (kW/kW)	SSEER (kW/kW)
VRF	Split or multi-split system	Electricity: Meter 1	1.0	3.5	3.5	3.5



5.0 Room Level System Input

Space Name (Actual)	System	Mechanical Supply?	Supply Specific Fan Power (W/(l/s))	Mechanical Exhaust?	Exhaust Specific Fan Power (W/(l/s))	Extract Flow Rate (ac/hr)
00_Lobby	VRF	Yes	1.60	No		
00_Resi Service corridor	VRF	Yes	1.60	No		
00_Retail	VRF	Yes	1.60	No		
00_Retail Refure	None	No	1.60	No		



6.0 Room Lighting Level Input

Space Name	Gain 1 Input Mode	Gain 1 Design Illuminance (Lux)	Gain 1 Lamp Efficacy (lm/W)	Gain 1 Light Output Ratio	Occupancy Sensing	Automatic Daylight Zoning for Lighting controls
00_Lobby	Inference	100	95	1	AUTO-ON-OFF (Foc = 0.90)	No
00_Resi Service corridor	Inference	100	95	1	AUTO-ON-OFF (Foc = 0.90)	No
00_Retail	Inference	600	95	1	NONE (Foc = 1.0)	No
00_Retail Refure	Inference	50	95	1	NONE (Foc = 1.0)	No

14 BREEAM STATEMENT



BREEAM Statement

**86 – 88 Broad Street,
Reading**

Prepared for:
Desco Ltd

Date:
May 2021

Project Issue Number:
SOL2105DES_01

VERSION CONTROL RECORD			
Contract/Proposal Number:		SOL2105DES_01	
Authors Name:		Callum Barnes	
Reviewers Signature:			
Issue	Description of Status	Date	Reviewer Initials
0	For Submission	21/05/2021	SMB

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EXECUTIVE SUMMARY

This document has been produced by Sol Environment Ltd (Sol) on the behalf of Desco Ltd to provide a technical overview of the BREEAM score that to proposed retail development at 86 – 88 Broad Street, Reading could achieve, were it do be formally assessed using the BREEAM Methodology.

Sol are sustainability consultants and licensed assessors for the Building Research Establishment (BRE) and work across the UK for Commercial, Residential and Industrial developers across the UK.

The **Building Research Establishments Environmental Assessment Method** (BREEAM) Scheme is the national standard for assessing the sustainability of new construction developments. BREEAM aims to differentiate between developments with higher environmental performance by providing a sustainability rating.

The BREEAM criteria review **all** sustainability aspects of the development and take into account a number of factors beyond pure building energy performance including site location, access and amenity, ecological benefit, material use etc.

Bankfoot APAM Ltd. are proposing the construction of a new building at 86 – 88 Broad Street, Reading to include 16 apartments and a 312m² commercial unit. The proposed development has been pre-assessed against the relevant BREEAM protocols to demonstrate the overall sustainability credentials.

Based on the initial review, the overall assessment score for the development achieves the required score for a 'Very Good' rating, in accordance with the requirements of Policy CC2 of the Reading Borough Local Plan (November 2019).

The further sections of this document provide a high-level review of the overall design and sustainability performance of the development and demonstrates the design of the proposed development, easily meets the requisite building performance (i.e., BREEAM 'Very Good').

When considering this accreditation, all other benefits of the proposed development should also be taken into account, particularly the improved retail and residential offer within the area. As the development is 'Shell Only' with no external spaces, no credits are available under Land Use and Water Sections.

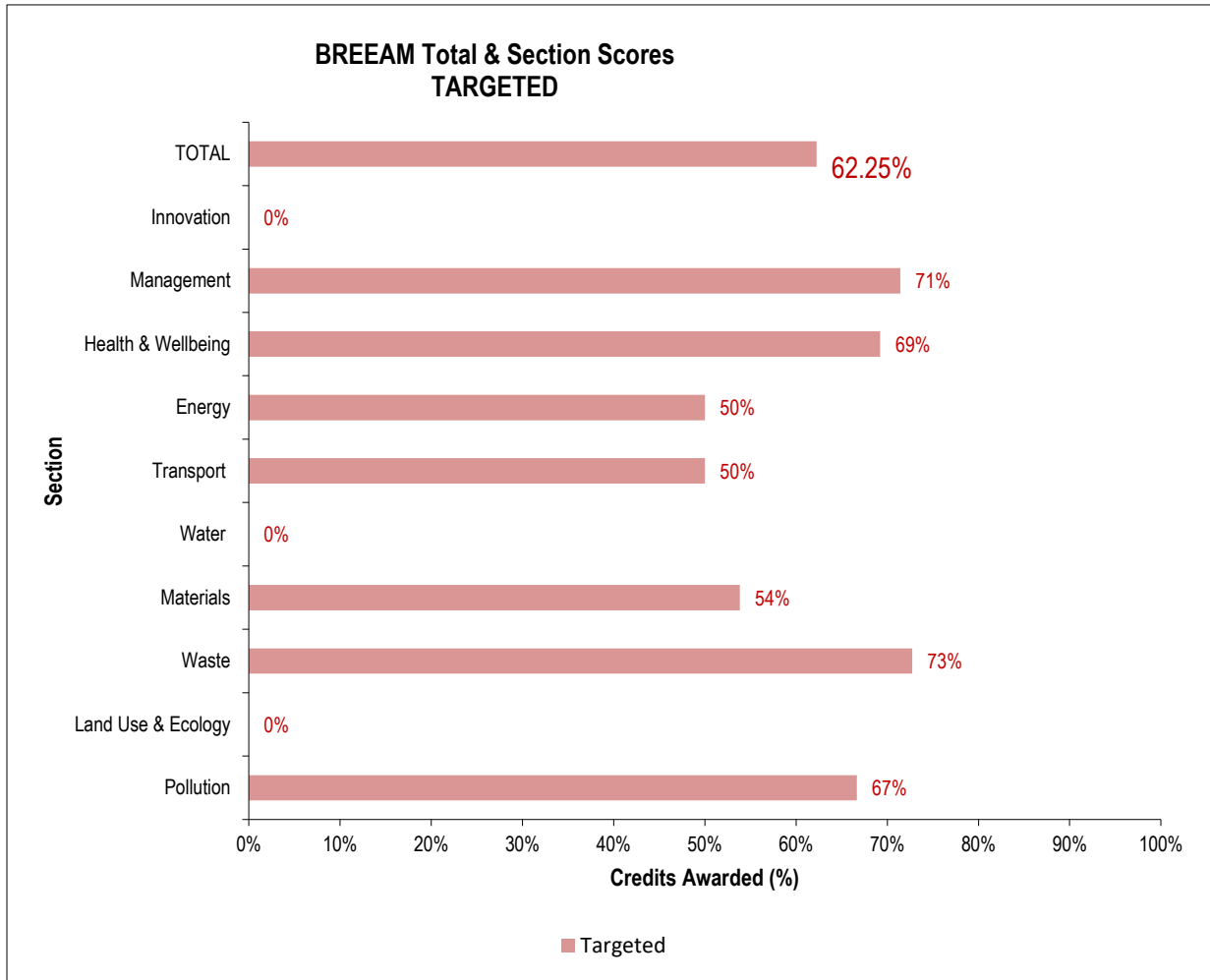


Figure 1: Predicted Percentage of the Total Score Targeted and a Breakdown of the Percentage of Credits Awarded in each Section for the development.

1. INTRODUCTION

The proposed retail development shall incorporate the development of a new building on 86 – 88 Broad Street, Reading to include 16 apartments and a 312m² commercial unit. This report covers the commercial unit. This report covers the commercial unit shell only.

Wherever possible, the design team have taken all reasonable measures to achieve the required score for an ‘*Very Good*’ rating, including achieving all the mandatory credits, were the development to be formally assessed using the BREEAM Methodology.

This report was informed by correspondence with the design team in addition to the following documents:

- Planning Issue drawings prepared by Suttonca Architects;
- Design Review Panel prepared by Suttonca Architects;
- Energy Statement prepared by Desco;
- Flood Risk Assessment and SuDS Strategy prepared by Heyne Tillett Steel; and
- Preliminary Ecological Appraisal prepared by Aspect Ecology.

Due to the current stage of the development, where detailed proposals are yet to be developed, the design team have worked on the principal that the credits awarded within this assessment would be only *likely* to be achieved by the final design.

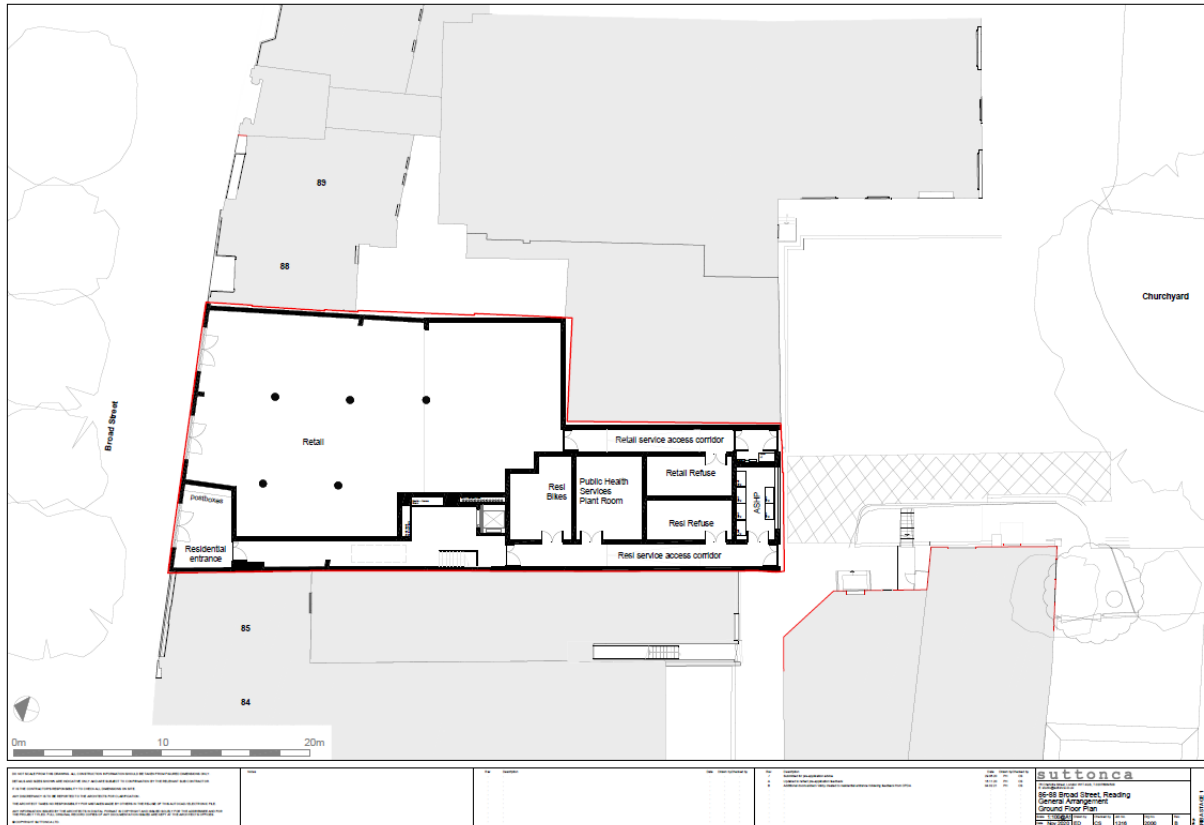


Figure 1: Proposed Site Layout

2. ASSESSMENT FINDINGS

Overall, the overall development could accrue the equivalent number of credits to achieve a ‘*Very Good*’ rating using the BREEAM 2018 New Construction (Shell Only) tool were it to be formally assessed using the BREEAM Methodology.

The total score of **62.25%** for the proposed scheme as a whole is within the ‘*Very Good*’ scoring bracket of 55 – 70%.

2.1 Graphical summary of findings

The figures below show a summary of the percentage of available credits which are likely to be achieved in each section (land use & ecology, management, etc.), given current design intent, for the proposed development.

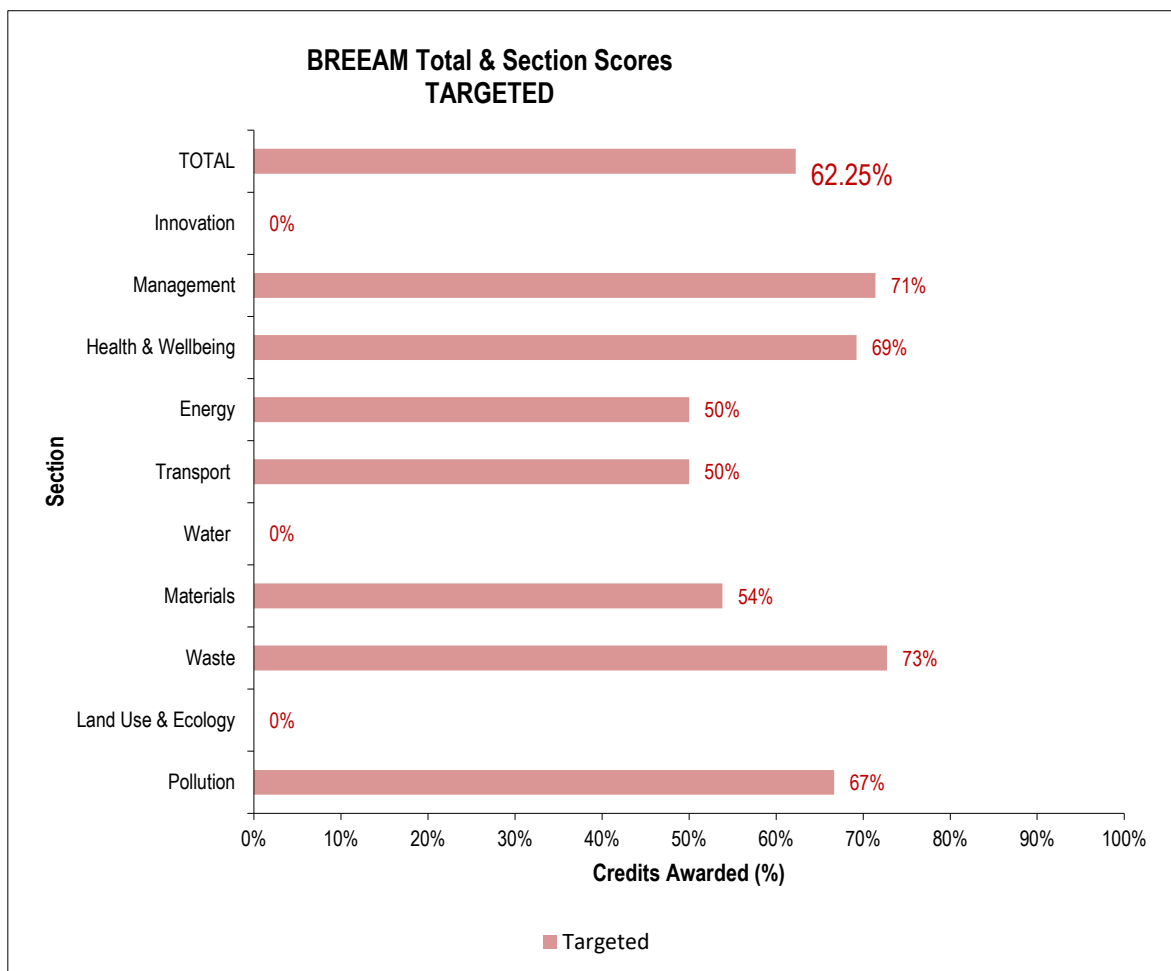


Figure ES2: Predicted Percentage of the Total Score Targeted and a Breakdown of the Percentage of Credits Awarded in each Section for the development.

2.2 Summary of performance by category

Figure ES2 shows that the proposals perform well in the following environmental categories;

- **Management:** *Credits available: 21 / Credits targeted: 15.* Early design team appointment and consultation, as well as stringent site practices will allow the development to score well within this section.
- **Health & Wellbeing:** *Credits available: 13 / Credits targeted: 9.* The proposed design will lead to a high score in this section through the specification of low VOC products, use of acoustically robust materials and adequate lighting and heating zoning control.
- **Energy:** *Credits available: 20 / Credits targeted: 9.* At the time of writing, final energy performance of the retail space is not known, as such a conservative estimate has been made. It is likely that this score will increase once the design is finalised. All lighting is provided through LED fittings and a significant proportion of the regulated building energy is provided through renewable sources. Innovation Credits have been awarded for this aspect.
- **Transport:** *Credits available: 7 / Credits targeted: 5.* The site location, and limited public transport from a BREEAM perspective mean that the site will be unable to achieve a majority of the credits within this section.
- **Water:** *Credits available: 0 / Credits targeted: 0.* As the specification of all sanitaryware and water consuming items will be the responsibility of the tenant, no credits are available under the water sections.
- **Materials:** *Credits available: 13 / Credits targeted: 7.* The selection of materials for the main building elements and external hard landscaping which have a low embodied environmental impact, with materials to have a Green Guide Rating of A or better; and that materials and products are responsibly sourced.
- **Waste:** *Credits available: 10 / Credits targeted: 7.* Stringent construction site waste management procedures, re-use of demolition material, implementation of policies to divert construction waste from landfill together with provision of ample recycling facilities ensures waste streams derived from both construction and operational phases is minimised or re-used / recycled.
- **Land Use & Ecology:** *Credits available: 0 / Credits targeted: 0.* As no external works will occur as part of the retail shell, no credits are available under this section.

- **Pollution:** *Credits available: 12 / Credits targeted: 8.* The proposed specification minimises the risk of surface water and flooding from all sources, night time light spill as well as noise impact to the adjacent, as such the development will be able to achieve a high score in this category.

3. CONCLUSION

Were the development to be formally assessed, it is likely to gain a total score of **62.25%** and falls within the 'Very Good' scoring bracket of 55% - 70% using the BREEAM 2018 New Construction tool.

The design of the proposed retail shell, meets the requisite building performance (i.e., BREEAM 'Very Good') and performs strongly in the following areas:

- Management
- Health and Well Being;
- Energy Performance;
- Materials Selection;
- Waste Management; and
- Pollution Control.

Bankfoot APAM Ltd. have designed a well performing and highly sustainable development that incorporates a very high level of building energy performance, efficiency and resource usage, as well as the redevelopment of an existing building, and improved amenity within the area.