

ENERGY STATEMENT

FOR

13 + 13A West Hampstead Mews London NW6 3BP

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ENERGY STATEMENT

1.0 EXECUTIVE SUMMARY

This Report has been produced by Johns Slater and Haward in response to Condition 12 of the London Borough of Camden. Full Planning Permission dated 4th April 2014. Ref 2014/1182/P.

To meet the planning requirement and achieve compliance under Part L of the Building Regulations 2010 the energy strategy for 13 + 13A West Hampstead Mews should demonstrate:

i. a reduction in carbon dioxide emmisions of 20% from on-site renewable energy generation.

This Report demonstrates that the strategy proposed for 13 + 13A West Hampstead Mews can not practically meet the required CO₂ emmissions reduction target by renewable sources due to the constraints of the site and the existing building that is to be converted to a dwelling.

Due to the lack of available roof, PV cells and solar thermal solutions are physically not practical.

The dwelling is not suitable for micro CHP and wind is not appropriate.

ASHP appears a suitable solution for both the commercial element and the domestic element.

In accordance with the London Plan toolkit the reduction in CO_2 emissions have been estimated as 32.88%.

By utilising ASHPs to provide the energy for the residential and commercial elements, an on-site renewable energy contribution of 30.39% can be demonstrated.



Fig. 1 - Carbon Dioxide Emissions after each stage of the Energy Hierarchy as proposed by Johns Slater and Haward.

	Carbon dioxide emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L of the Building Regulations Compliant Development	11.1	7.82
After energy demand reduction	8.05	7.82

After CHP	8.05	7.82
After renewable energy	7.45	7.82

Table 1 – CO₂ Emissions Summary

	Regulated Carbon dioxide savings	
	(Tonnes CO ₂ per annum)	
Savings from energy demand reduction	3.05	27.48
Savings from CHP	0	0
Savings from renewable energy	0.60	5.4%
Total Cumulative Savings	3.65	32.88%
Total Target Savings	3.08	20%

Table 2 - CO2 Savings





Fig. 2 - Energy Consumption for Baseline Building Total kWh per annum

Fig. 3 - Renewable Energy Generation kWh Per Annum

2.0 INTRODUCTION

2.1 About Us

Johns Slater and Haward are Building Services Consultants with expertise in Mechanical and Electrical installations for buildings with particular emphasis on energy installations. Johns Slater and Haward are accredited CIBSE Low Carbon Consultants.

2.2 <u>The Development</u>

The development at 13+ 13A West Hampstead Mews compises the conversion and refurbishment of an existing 2 story building fronting the road into a 2 bedroom house with attic space. The rear of the site which formerly was used as a vehicle workshop is to be rebuilt as new to provide office accomodation on ground, first and second floor

2.3 <u>The Criteria</u>

Clause 12 of the Full Planning permission granted by Camden Regeneration and Planning Development Management ref 2014/1182/P dated 4th April 2014 states:

'Before the development commences, an energy statement shall be submitted to the Council specifying how the proposed development follows the steps of the energy hierarchy and minimises its energy needs during both construction and occupation'

This Report outlines the expected energy performance of the residential and commercial elements of the development and the energy efficient measures that will be adopted.

It demonstrates how the development fulfils the relevant energy policies of the Camden Council

This Report also addresses the relevant energy policies contained within the London Plan:

- Policy 5.2 Minimising Carbon Dioxide Emissions
- Policy 5.3 Sustainable Design and Construction
- Policy 5.5 Decentralised Energy Networks
- Policy 5.6 Decentralised Energy in Development Proposals

• Policy 5.7 – Renewable Energy where feasible

The methodology employed to determine the potential CO₂ savings for this development is in accordance with the three step Energy Hierarchy outlined in the London Plan and Camden Council's Planning Guidance on Sustainability CPG 3 September 2013:

- **Be Lean** uses less energy improve the energy efficiency of the scheme
- **Be Clean** use energy efficiently supply as much of the remaining energy requirement efficiently using district networks or site wide networks and technology such as combined heat and power (CHP)
- **Be Green** use renewable energy offset a proportion of the remaining carbon dioxide emission by using renewable technologies.

Policy SC2.3 Passive Solar Design Maximising the efficient use of energy through passive solar design.

European Directive 2009/28/EC of 23rd April 2009 includes energy generated from 'aerothermal' sources, i.e. Air Source Heat Pumps (ASHP) as renewable energy technology.

It is noted that Camden Council's Planning Guidance on sustainability CPG 3 includes Air Source Heat Pumps (ASHP) as renewable energy technology.

It should be noted that the April 2014 Greater London Authority guidance on preparing energy assessments Clause 9.2 states:

"Detailed requirements for different types of renewable energy

Appendix 3 provides further guidance in relation to particular types of renewable energy systems. Where a particular type of renewable energy system is proposed, the relevant section should be consulted and required information provided as part of the energy assessment.

For the avoidance of doubt, heat pumps are categorised under this third and final element of the energy hierarchy (not the first element, 'be lean')".

2.4 Basis of Report

The residential unit has been assessed using SAP calculated by Elmhurst Energy Systems Software.

Full SAP worksheets for the residential unit are included in Appendix 1 of this Report.

The figures obtained from the completed SAP) have been used to generate the figures in this Report.

The commercial element of the building has been thermally modelled using dynamic software developed by TAS and incorporating standard weather data to provide thermal loads.

The resulting BRUKL output document is included in Appendix 2 of this report.

The following technologies have been appraised, in terms of technical, physical and financial feasibility, as potential low and zero carbon (LZC) systems for use on the Project:

- Gas fired combined heat and power (CHP)
- Photovoltaics
- Solar Thermal

- Air Source Heat Pumps (ASHP)
- Ground Source Heat Pumps
- Biomass CHP
- Biomass heating systems
- Wind turbines

3.0 BASELINE CALCULATIONS

For the purpose of this study the energy consumption and carbon dioxide emissions for the development have been estimated for different parts of the development using both preliminary design stage SAP calculation and preliminary SBEM calculations.

The baseline energy requirements (commercial) will be compliant with Part L2 2013. The baseline for the residential part is not compliant as it is an existing dwelling. We have however taken the residential baseline as gas fired boilers and the default air permeability (15m³/hr.m²).

Notional	KWh/yr	Tonnes/CO ₂ /yr			
Domestic Regulated Energy Use					
Total	11,269	3,730			
Non Domestic Regulated Energy Use					
Offices	14,256	7,370			
Regulated Energy Use					
Total	25,525	11,100			

Table 3 – Total Regulated Energy Use and CO₂ Emissions Baseline Building

4.0 DEMAND REDUCTION

4.1 <u>Passive Design Measures</u>

The development has been conceived initially to comply with Building Regulations Approved Document L. To meet the Regulations, the building has been optimised before any low or zero carbon (LZC) technologies are considered.

In optimising the proposal's energy efficiency at the outset, the benefits of any additional LZC technologies could also be fully recognised, rather than used to mask an otherwise low quality and energy intensive proposal. Further, the relatively low cost uplift in improving the basic build specification will reduce the requirement placed on any proposed LZC technology. As such, a generally superior benchmark construction would allow smaller installatons of particular technologies to be considered, making them inherently more economically viable.

4.1.1 General

The following passive design measures will be considered for incorporation into the scheme design to limit the building's baseline energy consumption.

- Façade treatment/solar shading
- Thermal mass/thermal insulation
- Passive solar heating

Measures to maximise natural daylighting

Whilst every measure that can be incorporated, within the normal commerical constraints, to minimise the effect of the solar gain it is not practically possible to totally prevent the solar gain from affecting the internal environment adversly with higher temperatures than would be normally comfortable.

4.1.2 Enhanced Building Fabric

The heat loss of different building elements is dependent upon their U value. A building with low U values provides better levels of insulation and reduced heating demand during the cooler months.

The proposed development at West Hampstead Mews will incorporate high levels of insulation and high performance glazing where possible to reduce the demand for space heating.

4.1.3 <u>U values (W/m²K)</u>

The U value of most components will be better than the minimum required for compliance under Part L 2013 of the Building Regulations. Some elements do not meet compliance as the building is part existing.

4.1.4 <u>Air Tightness</u>

Heat loss also occurs due to air infiltration. Although this cannot be eliminated altogether good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

Previous Part L Building Regulations (2013) sets a maximum air permeability of 5m³/m² at 50Pa.

The West Hampstead Mews development is likely to improve upon this to achieve $8m^3/m^2/hr$ at 50Pa through the application of best practice construction techniques for the residential unit and $3m^3/m^2/hr$ at 50 Pa for the commercial unit.

By improving the air tightness the natural air infiltration is reduced..

4.1.5 Orientation and Site Layout

Passive solar gain reduces the amount of energy required for space heating during the winter months.

The site is a confined one with the proposed development occupying nearly all of the site.

There is therefore little that can be done to affect the orientation of the buildings which naturally utilise the full extent of the site.

4.1.6 Lighting

The development has been designed where possible to improve daylighting in habitable spaces as a way of improving the health and wellbeing of its occupants.

4.2 Active Design Measures

4.2.1 High Efficiency Lighting

The development intends to incorporate low energy lighting fittings throughout. All light fittings will be specified as low energy lighting and will accommodate compact fluorescent (CFLs), fluorescent luminaires or LED luminaires.

Internal areas which are not frequently used will be fitted with occupany sensors whereas daylight areas will be fitted with daylight sensors.

4.2.2 Controls

The development will include good, simple to use controls for heating/cooling and domestic hot water in all apartments by dedicated room thermostats and programmable time clocks.

4.2.3 Energy Efficient Plant

All central plant will incorporate variable speed motors and controls to minimize energy consumption and optimize efficiency.

5.0 ENERGY DEMAND (BE LEAN)

The first step addresses reductions in energy use through the adoption of sustainable design and construction measures.

In accordance with this strategy, the proposed development will incorporate a range of energy efficiency measures including levels of insulation exceeding current Building Regulations and the installation of high performance glazing for both the residential and commercial units. The implementation of these measures would potentially reduce regulated CO_2 emissions when compared to a notional building.

The dwelling energy and CO₂ figures for the buildings have been drawn from the preliminary SAP assessments together with information from preliminary SBEM assessment for the non-domestic areas of the building.

Lean measures are expected to achieve a regulated CO₂ emission over Part L Building Regulation (baseline).

Actual	KWh/yr	Tonnes/CO ₂ /yr			
Domestic Regulated Energy L	Jse				
Total	2,573	1.34			
Non-Domestic Regulated Energy Use					
Total	12,977	6.71			
Regulated Energy Use					
Total	15,550	8.05			

Table 4 – Total Regulated Energy Use and CO2 Emissions after Be Lean

6.0 HEATING AND COOLING INFRASTRUCTURE (BE CLEAN)

6.1 Energy System Hierarchy

The second strategy takes into account the efficient supply of energy by prioritising decentralised energy generation.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to individual energy systems, thus reducing CO₂ emissions.

In accordance with the development at 13+13A West Hampstead Mews has been assessed in accordance with Section 5 of the Camden Planning Guidance on Sustainability CPG 3 with respect to Decentralised Energy have been determined in accordance with the following hierarchy as detailed in Fig 3 Decentralised Energy Flow Chart:

1. Is there a heat demand- YES

- 2. Is there an existing network in the vicinity- NO
- 3. Is there a network proposed in the next 3 years- NO
- 4. Can onsite CHP be provided- NO

6.2 Connection to Existing Low Carbon Heat Distribution Networks

The London Heat Map identifies existing and potential opportunites for decentralised energy projects in London.

An excerpt from the London Heat Map below shows that there are district heating mains in the vicinity of the site.

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It can be seen that the proposed development at 13+13A West Hampstead Mews is not in the vicinity of an existing Decentralised Energy network (1000m) or a proposed network within the next 3 years (500m)

6.3 Gas Fired Combined Heat and Power (CHP)

Combined heat and power (CHP), also known as cogeneration, is the generation of heat and power (usually electricity) at the same time.

In its simplest form a CHP system comprises a gas turbine, engine or steam turbine to drive an alternator. The resulting electricity is used primarily on site. The waste heat, in the form of steam or hot water, is collected and can be used to provide heat for industrial processes, for community heating and for space heating. It can also provide cooling using advanced absorption cooling technology. Not only does CHP enable the conversion of a high proportion of otherwise waste heat to usable heat, but it is very efficient because power is generated close to where it is being used (and thus electricity transmission lossed are minimised).

However, absorbtion cooling is significantly less efficient that cooling using compressor technology.

The predominate fuel used for CHP schemes is natural gas. Other fuels include oil, coal or even renewables (such as municipal and industrial waste, sewage gases, biogases, from anaerboic digestion, biodiesel, gasification, etc. and wood).

A total of around 70 - 80% (Gross Calorific Value) of the energy value of the gas is converted into heat, principally in the form of hot water which is used for space heating and domestic hot water, as in a normal central heating system. Between 10 - 25% is converted into electricity and the remainder(5 - 10%) is lost in the flue gases. This compares with a conventional gas central heating

boiler where 85% of the energy in the gas in converted into heat and the remaining 15% is lost in the flue gases.

CHP or Cogeneration is the production of electricity and useful heat from a single plant, improving the overall energy conversion efficiency from between 25 - 35% to around 80%. For a wide range of buildings, CHP can offer an economical method of providing heat and power which is less environmentally harmful than conventional methods. However, the economic viability of CHP is dependent on a consistent demand for heat and power.

Within the residential environment electricity demand is relatively consistent throughout the year. However, the heat load is weighted to the winter months when there is a space heating demand. A CHP engine would therefore be sized to meet the hot water load of the building, which stays relatively consistent throughout the year.

Unfortunately to provide hot water in summer requires the continous circulation via hot water at 75°C to provide local domestic hot water. These internal mains have both a significant energy loss and tend to lead to significant problems of overheating in internal corridors and also within the apartments.

It should be noted that the Greater London Authority guidance on preparing energy assessments April 2014 states:

"By way of general guidance, it is not expected that small purely residential developments (for example, less than 300 dwellings) include on-site CHP. Due to the small landlord electricity supplies, CHP installed to meet the base heat load would require the export of electricity to the grid. It is recognised that the administrative burden of managing CHP electricity sales at this small scale, where energy service companies (ESCOs) are generally not active, is too great for operators of residential developments to bear. If CHP is installed but does not operate because arrangement for CHP electricity sales are not concluded, the projected CO₂ savings will not materialise".

The residential element of this scheme relates to only 1 dwelling.

If CHP is not suitable for small residential schemes it is even less suited to small commercial schemes since they have no base load as the hot water demand is minimal.

It is therefore concluded that gas fired CHP is a totally inappropriate solution for this development.

7.0 <u>RENEWABLE ENERGY (BE GREEN)</u>

7.1 <u>General</u>

The Report has so far assessed the Lean and Clean measures which are appropriate at West Hampstead Mews The Report has identified that the proposed development will benefit from a high performing building fabric.

The third step in the London Plan assesses the feasibility of on-site renewable energy (Green) once Lean and Clean measures have been taken into account.

A range of renewable technologies were assessed to determine the most suitable technology for this development. Details for each renewable technology are outlined in the following sections. These included:

- Photovoltaic Panels
- Solar Thermal
- Ground Source Heat Pumps (GSHP)
- Air Source Heat Pumps

- Biomass Heating
- Wind Turbines

In determining the most appropriate renewable technology for the site, the following factors were considered:

- CO₂ savings achieved
- the site constraints
- payback and maintenance costs
- any potential visual impacts

The analysis identified ASHP as the most suitable renewable technology for this development.

7.2 Photovoltaic Panels

Photovoltaic (PV) generates electricity from sunlight. Small scale PV modules are available as roof mounted panels, roof tiles and conservatory or atrium roof systems. A typical PV cell consists of two or more thin layers of semi-conducting material, which is most commonly silicone. The electrical charge is generated when the silicon is exposed to light and is conducted away by metal contacts as direct current (DC).

Although the electrical output from a single cell is small, when coupled together a useful electrical output can be achieved. Therefore, PV cells are connected together and encapsulated, usually behind glass, to form a module or panel and any number of modules can be connected together.

The PV system generates no greenhouse gases and save approximatley 325kg of CO_2 per year or about 8 tonnes over the system's lifetime – for each kWp. A typical 1.5 - 2kWp system will produce enough electricity to supply almost half of an average family's annual demand, assuming that the heating is fuelled by gas and that the house has no other energy efficiency savings.

Photovoltaics are potentially a suitable renewable technology for most projects since:

- the installation of photovoltaics is relatively simple when compared to other renewable technologies
- photovoltaics are less visually instrusive when compared to other technologies such as wind turbines

Assessment of both the roof of the dwelling and the commercial unit indicate that it is impractical to provide a PV array due to the form and shape of the roof.

PV panels are therefore considered inappropriate for this development.

7.3 <u>Solar Thermal</u>

Solar thermal is one of the most commonly installed form of solar renewable is use today. Solar water heating can typically provided almost all of a domestic dwelling's hot water requirements during the summer months and about 50% year round.

There are three main components for domestic hot water systems – solar panels, a heat transfer system (pump) and a hot water cylinder. The solar panels (collectors) are usually fitted to the roof and collect heat from the sun's radiation. This heat is used to raise the temperature of the household water and is delivered by the heat transfer system which takes the heated water to the hot water cylinder for storage until use.

Solar thermal arrays have similar requirements as PV arrays in terms of their orientation and inclination.

The most effective use of solar thermal arrays would be to orientate them to the south at an inclination of about 30° .

Solar thermal arrays are available as evacuated tubes and flat plate collectors. Evacuated tubes are more efficient, produce higher temperatures and are more suited to the UK climate in general when compared to flat plate collectors.

The installation of solar thermal would not achieve a significant CO_2 savings as demonstrated by the SAP. In addition, solar thermal requires additional plumbing and space for hot water storage and the collector which is not available in the dwelling.

The hot water load for the commercial element is too small for solar thermal to be viable.

Solar thermal is therefore not considered inappropriate for this development.

7.4 Ground Source Heat Pumps

A heat pump works against natural flows to move heat energy betweem environments with different temperatures. An example of a commonly known heat pump is a domestic refrigerator.

Where heat pumps are used for heating applications, heat is removed from the source (ambient air, water, soil or earth) and then discharged where the heat is needed. Where cooling is required, the reverse happens and heat is removed and discharged into air, water, soil or earth.

A heat pump absorbs energy from one source, upgrades it in the compressor and then delivers this higher-grade energy to the desired location. It is this ability to absorb surrounding energy that makes a heat pump a renewable energy device. Heat pumps of the size required by this site generally have a reverse cycle, in which they reject heat into the ground, air or water, thus providing a low level of cooling that could be incorporated with careful design.

Heat pump efficiency is measured by what is called the Coefficient of Performance (COP). The COP is a measure of the amount of energy delivered (in kW), divided by the amount of energy needed to run the compressor and pumps (also in kW).

A ground source heat pump, as the name implies, extracts energy from the ground and has a COP of around 4. The high COP is due to the stable temperature found within the ground.

Ground source heat pumps would deliver space heating through a low temperature efficient distribution such as underfloor heating.

Ground loops each 100m deep, would be required to meet the peak load. This would require a significant amount of space on site and increase the amount of construction time. In addition, the capital cost of installing these ground loops would be very high.

Ground loops need to be seperated by a sufficient distance to avoid problems of interference between boreholes.

GSHPs are therefore considered to be totally inappropriate for this development.

7.5 <u>Air Source Heat Pumps</u>

Air source heat pumps (ASHPs) employ the same technology as ground source heat pumps (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

An advantage of heat pumps is that they can be used to provide cooling as well as heating. Due to the high levels of thermal insulation provided to new buildings and the internal gains from the occupants, equipment such as computers and artificial lighting commercial areas used as offices will generally have a cooling requirement rather than a heating requirement.

ASHP's are considered appropriate for this development due to the renewable 'portion' of energy they supply, which meets the councils Carbon Dioxide reduction targets.

A high temperature heat pump giving a COP of 3.44 has been assumed for the residential part of the development due to the use of radiators as heat emitters in some rooms.

7.6 Biomass Heating

Biomass heating usually involves the use of commercial energy crops in the form of fast growing trees such as willow or poplar for woodchips or waste wood products such as sawdust, pallets or untreated recylced wood for pellets.

These fuels are burned in either pellet stoves or larger scale boilers to provide heating and/or water heating. Man has been producing energy from biomass for centuries, and in many parts of the world it is still the principle source of heat. However, modern technologies are far more efficient that open fires and an increasing range of fuels are now being utilized.

Biomass is often called 'bioenergy' or 'biofuels'. These biofuels are produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products.

A biomass system designed for this development would be fuelled by wood pellets which have a high energy content. Wood pellets require less volume of storage than other biomass fuels. Pellet boilers also required less maintenance and produce considerably less ash residue.

A biomass boiler could supply the space heating and hot water demand to a communal heating scheme.

A biomass system, however, would not be an appropriate low carbon technology for the site for the following reasons:

- There is insufficient space onsite to accommodate a biomass installation.
- the burning of wood pellets releases substanially more NO₂ emissions when compared to high condensing gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would reduce the air quality in this area
- the storage and delivery of wood pellets would be difficult. Due to the very constricted nature of the site delivery of the fuel would be a substanial problem.
- pellets would need to be transported from other sites within the UK or abroad due to the lack of local pellet suppliers

The height of the flue to be taken to the top of the building with the corresponding high cost to ensure the products of combustion for the biomass boiler do not pollute the atmosphere to the detrimental effect on the residents and neighbours. The Clean Air Act prevents discharge of solid fuel flues in central London.

Whilst the use of biomass in the form of wood pellets is accepted as 'renewable' energy as trees can be planted to replace the trees that are used to make the pellets this is not always the case.

However, for a City centre site where the biomass will be obtained using commercial criteria (lowest price) it is highly unlikely that the origin of the timber is known or even traceable and extremely unlikely that any replacement planting of trees will be undertaken.

Indeed it is highly likely that the timber will have orginated from a distance, possibly abroad.

Accordingly, the associated energy use and CO₂ emissions due to the delivery of the fuel to the site will far exceed any theoretical considerations used to substaniate the use.

Biomass is therefore considered totally inappropriate for this development.

7.7 Wind Turbines

Wind turbines harness the wind to produce electrical power. The efficiency of a domestic system will depend on factors such as location and surrounding environment, and the electricity output is usually between 2.5 and 6kWs, but can be as low as 1kW. Calculating electricity generation from a wind

turbine requires consideration of the characteristics of wind. Wind power is proportional to the cube of the wind's speed which mean that large changes in potential output can result from relatively minor increases in wind speed. Since wind speed increases with height, a typical wind turbine is mounted high on a mast or tower and a ideal location is on a smooth top hill with a flat, clear exposure and is free from obstructions such as buildings, forests or other large trees that can cause excessive turbulance.

Wind turbines were not considered appropriate for this development due to the low CO₂ savings achieved, the significant impact on the roof space and proximity of the adjacent buildings. The installation of wind turbines also has a significant visual impact on the building.

It is generally acknowledged that urban wind turbines do not, in practice, achieve anything like the theroretical output generated by desk top studies.

The use of wind turbines in urban locations can also generate problems related to noise, flicker and vibration.

There is insufficient space on the site for a wind turbine installation.

Wind turbines are therefore considered to be totally inappropriate for this development.

8.0 RENEWABLE ENERGY SUMMARY

The factors taken into account in determining the appropriate renewable technology for this Project included carbon reduction capability, renewable energy produced estimated capital cost, simple payback, lifetime, level of maintenance and level of impact on external appearance.

The feasibility study demonstrates that ASHPs would be the most feasible option for the proposed development at West Hampstead Mews.

By using ASHP's on this development to heat the office, a saving of 707kgCO₂/annum can be saved by not using gas.

9.0 CONCLUSIONS

9.1 <u>CO₂ Emissions</u>

In line with the London Plan three step energy hierarchy, the regulated CO₂ emissions for the development at West Hampstead Mews have been reduced once energy efficiency measures and on-site renewable energy generation are taken into account.

i. <u>Be Lean - use less energy</u>

In accordance with this strategy, the development will incorporate a range of energy efficient measures including levels of insulation exceeding Building Regulations, efficient light fittings and the installation of high performance glazing.

ii. <u>Be Clean – supply energy efficiently</u>

Both CHP and district systems have been considered for West Hampstead Mews and have both been rejected since they both use significantly more energy and the estimated CO_2 emissions are significantly better than if CHP were used and of the same order as using the district mains.

To impliment CHP or use the district systems would require a central heat network through the building using low temperature hot water which would cause the communal areas to overheat.

The West Hampstead Mews Development is below the recognised threshold applicable to CHP of 300 units.

iii. <u>Be Green – use renewable energy</u>

The feasibility study undertaken determined the most appropriate renewable technology for this development was the use of ASHPs.

ASHPs were considered to be best suited to this development due to:

- the amount of CO₂ savings achieved 32.88% over the notional building
- the significant on site renewable energy generation at 30.39%
- The ease of installation compared to other renewable technologies

The solutions proposed by Johns Slater and Howard will ensure that a high quality internal environment will be provided for all the residents from renewable and efficient energy sources.

The figures show a significant CO_2 reduction in regulated emissions when compared to a baseline scheme). This illustrates that the Energy Strategy proposed for West Hampstead Mews achieves a significant CO_2 saving.

The total percentage saving in CO_2 emissions afforded by the 3 step hierarchy for West Hampstead Mews is estimated as 32.88%.

	Energy Element	Tonnes CO ₂ emissions per annum	Comments
1.	Baseline Part L (2013) (Regulated)	11.1	Derived from target emission rates from both SAP and SBEM (regulated energy)
2.	Domestic (Regulated)	1.34	
3.	Offices	6.11	
4.	Regulated Emissions Total (2+3)	7.45	
5.	CO ₂ savings	3.65	
6.	Non Regulated Emissions Total	7.82 equipment	
7.	Total Building Emissions (4+6)	15.27	
8.	Total Baseline CO ₂ Emissions	11.1	Estimated for basic building
9.	20% Carbon Emissions Target	3.08	

Table 5 – CO₂ Emissions

9.2 On Site Renewable Generation

The use of ASHPs for the generation of heat for space heating will lead to a significant on-site renewables generation.

	Energy Element	KWh/y	Comments	
1.	Domestic (Dwelling) (Regulated)	2,573	Based on SAP Data.	
2.	Offices (Grd / 2nd)	14,256	Based on SBEM Data.	
3.	Regulated Energy Total (1+2)	16,829		
4.	Non Regulated Energy Total	15,123	Refer to notes titled 'Non Regulated Energy'	
5.	Total Building Energy (3+4)	31,952		
6.	10% Renewables Requirement	3,195		
7.	Renewable Energy Generated	9,710	Equates to 30.39% renewable energy contribution (Total energy) 8,242.00 kWh commercial 1,468.00 kWh residential	

Table 6 – Renewable Energy

Johns Slater and Haward......13 + 13A West Hampstead Mews – Energy Report.......March 2016.......EB/5223/ES/A

APPENDIX 1

13+13A WEST HAMPSTEAD MEWS

SAP WORKSHEET FOR RESIDENTIAL UNIT



	Full SAP	Calculation P	rintout	
Property Reference Survey Reference Property: NW6	e: S1502-HOUSE : ASHP			Issued on Date: 05.Aug.2015 Prop Type Ref:
SAP Rating: 74 C C Environmental:77 C G	O2 Emissions (t/year): 2.35 eneral Requirements Compliance: Fail	DER: 26.23 Pass DFEE:66.86 Fail	TER: 26.23 TFEE:58.95	Percentage DER <ter: %<br="" -0.01="">Percentage DFEE<tfee: %<="" -13.42="" th=""></tfee:></ter:>
CfSH Results Version:	ENE	1 Credits: N/A ENE2	Credits: N/A EN	E7 Credits: N/A CfSH Level: N/A
Surveyor: lan Tur Address: The Fo Client:	vey, Tel: 01763 273315 Ily, Buntingford, Herts, SG9 9EB			Surveyor ID: 6195-0001
Software Version: Elm SAP version: SAP 201	hurst Energy Systems SAP2012 Calc 2, Regs Region: England (Part L1A 2	ulator (Design Syste 013), Calculation Ty	m) version 3.0 pe: New Build	4r05 (As Designed)
CALCULATION DETAI SAP2012 - 9.92 input d	LS for survey reference no 'ASHP' ata (DesignData) -			Page: 1 of 32
SAP2012 Input Data (House)	29/02/2016			
FullRefNo:	ASHP			
Regs Region: SAP Region: Postcode: DwellingOrientation: Property Type: Storeys: Date Built: Sheltered Sides: Sulight Shade: Measurements lat Storey: Jard Storey: Jard Storey: Living Area: Thermal Mass: Thermal Mass: Thermal MassValue: External KasValue: External KasValue: External MassValue: External MassValue: External Roofs External Roofs External Rooff External Rooff External Rooff External Rooff External Rooff External Rooff External Rooff External Rooff External Rooff Description Opening Type 1 Opening Type 1 Opening Type 2 Opening Type 3 Opening 4 Opening 5 Opening 4 Opening 5 Opening 7 Conservatory: Draught Proofing: Draught Proofing: Draught Proofing: Draught Proofing: Pressure Test: Designed g50: AsBuilt g50: Property Tested: Mechanical Ventilation My System Present Windows In Not Weather	End England Thames Valley NM6 North House, Detached 3 2015 2 Average or unknown Perimeter, Floor Area, Storey Height 25.2, 40.32, 2.7 20.8, 24.73, 1.98 35 m2, fraction: 32.98 Simple calculation Low 100 Nett Area, Gross Area, Kappa, Element, Con 103.33, 124.74, 9, SolidWallPlasterOnDabsIns 20.8, 20.8, 16, TimberWallTwoLayers, Timber Nett Area, Gross Area, Kappa, Construction 32.32, 33.63, 9, Plasterboard, insulated flat rr 15.59, 15.59, 9, Plasterboard, insulated flat rr 15.87 table, Solid Door, , 3.00 Manufacturer, Window, Double Low-E Hard 0.10 SAP table, Solid Door, , 3.00 Manufacturer, Noor, Orientation, Pitch Solid Door, Wall 1, North, None, 0, 0, 0, 0, Window, Wall 1, East, None, 0, 0, 0, 0, No Default 0.15 True 5 10 False Yes Windows balf open	struction, Type, ShelterF nsul, Solid, 0, 0.24, Gros 11, Solid, 0, 0.32, Gross Frame, 0, 0.15, Gross Flament, UValueFinal popt, 0.15 ShelterFactor, UValueFina Hation, Ground Floor - S SolterFactor, UValueFina Jation, Ground Floor - S SolterFactor, UValueFina SolterFactor, UValueFina Hation, Ground Floor - S SolterFactor, UValueFina Jation, Ground Floor - S SolterFactor, S SolterFactor, Ground Floor - S SolterFactor, Ground Floor - S SolterFactor, Jation, G SolterFactor, G S	actor, UValueFina ss l lid, 0, 0.18 Frame Type, Frame Ratio, Wide Overha	l e Factor, D Value ang, Width, Height, Count, Area, Curtain Closed
Night Ventilation Air Change Rate Approved Installation DataType Database Ref Number DuctType Decentralised MV 1 2 Chimmeys MHS: Chimmeys SHS: Chimmeys SHS: Chimmeys Total: Open Flues MHS:	Yes 4.00 Yes Database Mechanical extract ventilation - decentralis 500017 Rigid Sfp. Fan & Room Type, Count 0.35, In Room Fan Kitchen, 1 0.25, Through Wall Fan Other Wet Room, 3 0 0 0 0 0 0 0	ed .		
Open Flues Other: Open Flues Other: Intermittent Pans: Passive Vents: Flueless Gas Fires: Cooling System	0 0 0 0 0 0 0 0 0			

LARGE HEAT FAILURE	12	
Percentage of LEL Fittings:	12	
External Lights Fitted:	No	
Electricity Tariff:	Standard	
Main Heating 1	ACHD	
Percentage	100	
MHS Code	Electricity PET Heat pump air-to-water	
Boiler Efficiency Type	SAF Table	
Efficiency	175.1	
MHS Controls	0 CHD Time and temperature zone control	
Boiler Interlock	No	
Ctrl SAP Code MCS Installation Certifi	2207 cateYes	
Pumped	Pump in heated space	
Heat Pump Age	2013 or later	
Flow Temperature	Normal (> 35°C)	
Under Floor Heating	Yes - Pipes in thin screed	
Main Heating 2 Heating Systems Interaction	None Each system heats separate parts of dwelling	
Smoke Control Area	Unknown	
Community Heating Secondary Heating	None	
Water Heating		
Type	MainHeating1	
Low Water Usage	Yes	
SAP Code	901	
Suplementary Immersion Hot Water Cylinder	No	
Cylinder Type	HotWaterCylinder	
Loss Factor	1.70	
Cylinder Volume	125.00	
Cylinder Stat Pipeworks Insulated	Yes Fully insulated primary pipework	
Cylinder in Heated Space	Yes	
Separate Time Control	Yes	
Waste Water Heat Recovery Syste	none	
PV Unit	None	
Terrain Type:	None Urban	
Small Scale Hydro	None	
opectal reactive	and and a second s	
DWELLING AS DESIGNED		
Detached House, total floor	area 106 m²	
This report covers items inc	luded within the SAP calculations.	
It is not a complete report	of regulations compliance.	
the most and most		
1a TER and DER		
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Ta TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emissio	icity y) n Rate (TER) 26.23 kg/m²	
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<pre>Ia TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emissib Ib TFEE and DFEE Target Fabric Energy Efficien Dwelling Fabric Energy Efficien Excess energy = 7.9 kWh/m² (2 Fabric U-values Element Average External wall 0.23 (max. 0 Floor 0.18 (max. 0 Openings 1.74 (max. 2 2a Thermal bridging Thermal bridging calculated 13 Air permeability Air permeability at 50 pasca Maximum 4 Heating efficiency Main heating system: Air-to-water heat pump Secondary heating system: 5 Cylinder insulation Hot water storage Permitted by DBSCG 1.70 Primary pipework insulated: 6 Controls</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Pail 13.4%) Highest .30) 0.32 (max. 0.70) OK .25) 0.18 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK using default y-value of 0.15 ls: 5.00 (design value) 10.0 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes	OK
<pre>Ia TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emissib Ub TFEE and DFEE Target Fabric Energy Efficien Dwelling Fabric Energy Efficien Excess energy =7.9 kWh/m² (Second - 2000 (max) (max</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Pail 13.4%) Highest .30) 0.32 (max. 0.70) OK .25) 0.18 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK using default y-value of 0.15 ls: 5.00 (design value) 10.0 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes Time and temperature zone control	OK OK DK
<pre>Ia TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emission Ib TFEE and DFEE Target Fabric Energy Efficien Dwelling Fabric Energy Efficien Excess energy =7.9 kWh/m² (Stream Average External wall 0.23 (max. 0) Floor 0.18 (max. 0) Floor 0.15 (max. 0) Openings 1.74 (max. 2) Thermal bridging Thermal bridging calculated of 3 Air permeability Air permeability at 50 pascal Maximum 4 Heating efficiency Main heating system: Air-to-water heat pump Secondary heating system: 5 Cylinder insulation Hot water storage Permitted by DBSCG 1.70 Primary Dipework insulated: 6 Controls Space heating controls:</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Fail 13.4%) Highest .30) 0.32 (max. 0.70) OK .25) 0.18 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK using default y-value of 0.15 ls: 5.00 (design value) 10.0 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes Time and temperature zone control	OK OK OK OK
<pre>ia TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emissi buelling Carbon Dioxide Emissi b TFEE and DFEE Target Fabric Energy Efficie Dwelling Fabric Energy Efficie Excess energy =7.9 kWh/m² (1) 2 Fabric U-values Element Average External wall 0.23 (max. 0 Floor 0.18 (max. 0 Openings 1.74 (max. 2 2a Thermal bridging Thermal bridging calculated 1 3 Air permeability Air permeability Air permeability at 50 pascal Maximum 4 Heating efficiency Main heating system: 5 Cylinder insulation Hot water storage Permitted by DBSCG 1.70 Primary pipework insulated:</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Fail 13.4%) Highest .30) 0.32 (max. 0.70) OK .25) 0.18 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK .00) 3.00 (max. 3.30) OK .01 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes Time and temperature zone control Cylinderstat	OK Electric OK OK OK
<pre>la TER and DER Puel for main heating:Electr Fuel for main heating:Electr Target Carbon Dioxide Emissi Duelling Carbon Dioxide Emissi Duelling Carbon Dioxide Emissi Duelling Fabric Energy Efficient Duelling Fabric Energy Efficient Excess energy =7.9 kWh/m² (1) 2 Fabric U-values Element Average External vall 0.23 (max. 0) Floor 0.18 (max. 0) Roof 0.15 (max. 0) Openings 1.74 (max. 2) 2a Thermal bridging Thermal bridging calculated 13 Air permeability at 50 pascal Maximum 4 Heating efficiency Main heating system: Air-to-water heat pump Secondary heating system: 5 Cylinder insulation Hot water storage Permitted by DBSCG 1.70 Primary pipework insulated: 6 Controls Space heating controls: Hot water controls:</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Fail 13.4%) Highest .30) 0.32 (max. 0.70) OK .20) 0.16 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK using default y-value of 0.15 1s: 5.00 (design value) 10.0 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes Time and temperature zone control Cylinderstat Independent timer for DHW	OK Electric OK OK OK OK
<pre>la TER and DER Fuel for main heating:Electr Fuel factor:1.55 (electricit) Target Carbon Dioxide Emissi Dwelling Carbon Dioxide Emissi D TFEE and DFEE Target Fabric Energy Efficien Dwelling Fabric Energy Efficien Dwelling Fabric Energy Efficien Excess energy =7.9 kWh/m² (2 Fabric U-values Element Average External wall 0.23 (max. 0 Floor 0.18 (max. 0 Openings 1.74 (max. 2 2 Thermal bridging Thermal bridging calculated 1 Thermal bridging calculated 1 Thermal bridging calculated 1 Air permeability Air permeability at 50 pasca Main heating system: Air-to-water heat pump Secondary heating system: 5 Cylinder insulation Hot water storage Permitted by DBSCG 1.70 Primary pipework insulated: 6 Controls Space heating controls: Hot water controls:</pre>	icity y) on Rate (TER) 26.23 kg/m ² sion Rate (DER) 26.23 kg/m ² OK ncy (TFEE)59.0 kWh/m ² iency (DFEE)66.9 kWh/m ² Fail 13.4%) Highest .30) 0.32 (max. 0.70) OK .20) 0.16 (max. 0.70) OK .20) 0.16 (max. 0.35) OK .00) 3.00 (max. 3.30) OK using default y-value of 0.15 1s: 5.00 (design value) 10.0 Heat pump with radiators or underfloor - None Measured cylinder loss: 1.70 kWh/day OK Yes Time and temperature zone control Cylinderstat Independent timer for DHW	OK Electric OK OK OK OK

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CALCULATION DETAILS for survey reference no 'ASHP' SAP2012 - 9.92 input data (DesignData) -

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Minimum	75%	OK

8 Mechanical ventilation		
Continuous extract system (decen	ralised)	
Specific fan power:	0.3500 0.2500	
Maximum	0.7	OK

9 Summertime temperature		
Overheating risk (Thames Valley)	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North:	1.20 m ² . No overhang	
Windows facing East:	18.00 m ² . No overhang	
Air change rate:	4.00 ach	
Blinds/curtains:	None	
10 Key features		
None		

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAF 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		Store	y height			Volume			
		(m2)			(m)			(m3)			
Ground floor		41.1800	(1b)	х	2.7000	(2b)	=	111.1860	(1b)	- (3b)
First floor		40.3200	(1c)	х	2.7000	(2c)	π.	108.8640	(1c)	- (3c)
Second floor		24.7300	(1d)	x	1.9800	(2d)	=	48.9654	(1d)	- (3d)
Total floor area TFA = $(1a) + (1b) + (1c) + (1d) + (1e)$ (1n)	106.2300								(4)		
Dwelling volume		(3	3a)+(3	b) + (3c)	+(3d)+(3e)	(3n)	-	269.0154	(5)		

2. Ventilation rate

			a ha	(and a second	والمسرط فيترك والمراجع								
					main heating	se	condary heating		other	tota	1 n	n3 per hour	
Number of chin	meys				0	+	0		0	-	0 * 40 =	0.0000	(6a)
Number of open	1 flues				0	+	0	+	0	á l	0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans									0 * 10 =	0.0000	(7a)
Number of pass	sive vents										0 * 10 =	0.0000	(7b)
Number of flue	eless gas f	ires									0 * 40 =	0.0000	(7c)
										1.1.1.3	Air change	s per hour	
Infiltration of Pressure test	due to chim	neys, flues	and fans	= (6a)+(6b))+(7a)+(7b)+	+(7c) =				0.0000	/ (5) =	0.0000 Yes	(8)
Measured/desig	in d20											5.0000	10.05
Number of side	es sheltered	đ										0.2500	(18)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration n	ate adjuste	ed to includ	le shelter f	actor					(21) = (18)	x (20) =	0.2125	(21)
	Jan	Feb	Mar	Anr	May	Jun	.711]	Aug	Sen	ÖCT	Nov	Dec	
Wind sneed	5 1000	5.0000	4 9000	4 4000	4 3000	3 8000	3 8000	3 7000	4 0000	4 3000	4 5000	4 7000	1221
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	(222)
Adi infilt rat	P					0.0000							1
	0 2709	0 2656	0.2603	0 2338	0.2284	0 2019	0.2019	0 1966	0.2125	0 2284	0.2391	0.2497	(22b)
Mechanical ext	ract ventil	lation - dec	entralised	014550	010201	0.2012		0.2000	2 (2.222	202222			(===;;)
If mechanical	ventilation	n ;										0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

West Incode and heat Inco navameter

a. neue robbe	es and hear a	togs paramet											

Element				Gross	Openings	Ne	tArea	U-value	AxU	K-	value	AxK	
				m2	m2		m2	W/m2K	W/K	kJ	/m2K	kJ/K	
Opening Type	1 (Uw = 1.60))				19	,2000	1.5038	28,8722				(27)
Opening Type	2					2	.2100	3.0000	6.6300				(26)
Opening Type	3 (Uw = 1.60	0)				1	.3100	1.5038	1.9699				(27a)
Heat Loss Flo	oor 1					41	.1800	0.1800	7.4124				(28a)
Wall 1			3	24.7400	21.4100	103	.3300	0.2400	24.7992				(29a)
Wall 2				11.3400		11	.3400	0.3200	3.6288				(29a)
Wall 3				20.8000		20	.8000	0.1500	3.1200				(29a)
External Roof	E 1			33.6300	1.3100	32	.3200	0.1500	4,8480				(30)
External Roof	£ 2			5.4000		5	.4000	0.1300	0.7020				(30)
External Roof	E 3			15.5900		15	.5900	0.1600	2.4944				(30)
Total net are	a of externa	al elements	Aum(A, m2)			252	.6800						(31)
Fabric heat 1	Loss, $W/K = S$	Sum (A x U)					(26)	(30) + (32) =	84.4769				(33)
Thermal mass	parameter (7	CMP = Cm / T	(FA) in kJ/m	2K								100.0000	(35)
Thermal bride	res (Default	value 0.150	* total ex	posed area								37,9020	(36)
Total fabric	heat loss									(33)	+ (36) =	122.3789	(37)
Ventilation h	neat loss cal	culated mor	thly (38)m	= 0.33 x (2	25)m x (5)								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.2463	45 7747	45.3030	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	(38)

Heat transfer coeff 168.6252 Average = Sum(39)m / 12 = 165.7664 166.7664 166.7664 166.7664 166.7664 166.7664 168.1536 167.6819 166.7664 166.7664 166.7664 (39) 167.1132 (39) Aug 1.5699 May 1.5699 Jan Feb Mar Apr 1.5699 Jun Jul Sep 1.5699 Oct Nov Dec 1.5874 1.5829 1,5699 (40) 1,5731 (40) HLP 1.5785 1.5699 1.5699 1.5699 1.5699 HLP (average) Days in month 31 (41) 31 28 31 30 31 30 31 31 30 31 30

4. Water heating energy requirements (kWh/year) Assumed occupancy Average daily hot water use (litres/day) 2.7902 (42) 100.4673 (43) Feb Jan Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 Jaily hot water use
 110.5140
 106.4953
 102.4766

 Energy conte
 163.8890
 143.3384
 147.9124
 94.4392 102.4766 106.4953 98.4579 90.4205 90.4205 94.4392 98.4579 110.5140 (44) 133.8958 146.157 Total = Sum(45)m = 158.7178 (45) 1580.7412 (45) 128.9536 123.7341 106 7731 98.9410 113.5362 114.8922 146.1577 Energy content (annual) Distribution loss (46)m = 0.15 x (45)m 24.5834 21.5008 22.1869 19.3430 17.2338 20.0844 21.9237 23.8077 (46) 18.5601 16.0160 14.8411 17.0304 Water storage loss: Walter Storage Toss: Store volume a) If manufacturer declared loss factor is known (kWh/day): Temperature factor from Table 2b 125.0000 (47) 1.7000 (48) 0.5400 (49)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 Den et and et al. (1) and (2) and	Enter (49) or	(54) in (55)										0.9180	(55)
Section Section <t< td=""><td>Total storage</td><td>28.4580</td><td>25.7040</td><td>28.4580</td><td>27.5400</td><td>28.4580</td><td>27.5400</td><td>28.4580</td><td>28.4580</td><td>27,5400</td><td>28.4580</td><td>27.5400</td><td>28.4580</td><td>(56)</td></t<>	Total storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27,5400	28.4580	27.5400	28.4580	(56)
Num al. 211/00 121/00 <th< td=""><td>Primary loss</td><td>28.4580 23.2624</td><td>25.7040 21.0112</td><td>28.4580 23.2624</td><td>27.5400 22.5120</td><td>28.4580 23.2624</td><td>27.5400 22.5120</td><td>28.4580 23.2624</td><td>28.4580 23.2624</td><td>27,5400 22,5120</td><td>28.4580 23.2624</td><td>27.5400 22.5120</td><td>28.4580 23.2624</td><td>(57) (59)</td></th<>	Primary loss	28.4580 23.2624	25.7040 21.0112	28.4580 23.2624	27.5400 22.5120	28.4580 23.2624	27.5400 22.5120	28.4580 23.2624	28.4580 23.2624	27,5400 22,5120	28.4580 23.2624	27.5400 22.5120	28.4580 23.2624	(57) (59)
Name of the set of the	Solar input	0.0000	190.0536 0.0000	199.6328 0.0000	179.0056 0.0000	175-4545 0.0000	156.8251 0.0000	150.6614 0.0000	165.2566 0.0000 Solar inn	164,9442 0.0000	185.6162 0.0000 months) = S	196.2097 0.0000 um(63)m =	210.4382	(62) (63) (63)
Acts plane there water. Notified in the first set of the set of t	Output from w/l	n 215.6094	190.0536	199,6328	179.0056	175,4545	156.8251	150.6614	165.2566 Total p	164.9442	185.6162 h/vear) = S	196.2097 um(64)m =	210.4382	(64)
Internal partie (see PADe 1 and 1) Terminal parties (see PADe 1 and 1) Termi	Heat gains from	n water h 95.8694	eating, kWh, 85.0322	/month 90.5572	82.9187	82.5179	75.5437	74.2742	79.1271	78-2432	85.8967	88.6390	94.1500	(65)
Control of 100 100 100 100 100 100 100 100 100 10	5 Internal ga	ins (see '	Table 5 and	5a)										
Jam Fei Bar Mar Mar Star Jun Ann Bar OCL DOD DOD and mage main inclusion of the section of the sectin of the sectin of the sectin of the section of the sectin of the	Metabolic gains	(Table	5). Watts						•••••					
12.9 2.9 <th2.9< th=""> <th2.9< th=""></th2.9<></th2.9<>	(66)m	Jan 139.5100	Feb 139.5100	Mar 139.5100	Apr 139.5100	May 139_5100	Jun 139.5100	Jul 139,5100	Aug 139.5100	Sep 139.5100	Oct 139.5100	Nov 139,5100	Dec 139.5100	(66)
The Solid Solid Soli	Appliances gains	23.9425	21.2655	17.2943	13.0929	9.7871 or 1.13a)	B.2627	8.9281	11.6051	15.5763	19.7777	23.0835	24.6080	(67)
M. 5200 M. 5200 S. 5300 S. 5300 M. 5200 M. 5300 M. 5300 <t< td=""><td>Cooking gaine</td><td>266.0241</td><td>268.7846</td><td>261.8282</td><td>247.0189</td><td>228.3249</td><td>210.7551 see Table</td><td>199.0174</td><td>196.2569</td><td>203.2133</td><td>218.0225</td><td>236.7166</td><td>254.2864 (</td><td>(68)</td></t<>	Cooking gaine	266.0241	268.7846	261.8282	247.0189	228.3249	210.7551 see Table	199.0174	196.2569	203.2133	218.0225	236.7166	254.2864 ((68)
adde e.g. coperation inspective valued) (Table 5) there has in all (19) 11100 111000 111000 111000 -111000 -11100000 -1110000 -1110000 -1110000 -1110000 -1110000 -1110000 -1	Pumps, fans	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510 3.0000	36.9510	36.9510 3.0000	36.9510	36,9510 3.0000	36.9510 3.0000	36.9510 ((69) (70)
Ander Bezing schm (Table 3) sets) increase (1) sets (1) i	Losses e.g. eva	poration	(negative -	values) (Tal -111.6080	ole 5) -111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080 ((71)
Stati internal spice Stati control Stati contro Stati control St	Water heating g	ains (Ta)	ble 5) 126,5360	121.7167	115.1648	110.9111	104.9217	99.8309	106.3536	108.6712	115.4525	123.1098	126.5457 ((72)
- Diar gala Tabler gala Table	Total internal	gains 186.6763	484.4391	468.6921	443.1296	416.8761	391.7925	375.6294	382.0687	395.3138	421.1058	450.7629	473.2930 ((73)
. Bolar gains Table gains Tab														
Can Area Boller Flux gr proting and section as positive as	 Solar gains 		•••••		****									
Open 1.2000 20.6334 0.7200 0.7000 0.7700 1.3.4763 (%) Sate 1.1000 26.6000 0.7200 0.7000 1.0000 13.4454 (%) Sate 1.1000 26.6000 0.7200 0.7000 1.0000 13.4454 (%) Sate 1.1000 26.6000 0.7200 0.7000 1.0000 13.4454 (%) Sate 1.1000 26.6000 0.7200 9.7000 1.0000 13.4454 (%) Sate 1.0000	[Jan]			1	Area m2	Solar flux Table 6a W/m2	C Specif or J	g ic data Table 6b	Specific or Tab:	FF data le 6c	Acc fact Table	ess or 6d	Gains W	
Double is the set of the living area from the living area (1000000000000000000000000000000000000	North			1.2	2000	10.6334		0.7200	(0.7000	0.7	700 700	4,4567 123.4763	(74) (76)
During same is 1, 366 22, 100, 469, 068 452 511 55 640 1273, 2810 1271, 3946 1222, 1658 1035, 405 94, 394, 395, 972, 179, 9675 117, 7448 (4) we same intermal temperature (insting season) 	South			1.1	3100	26.0000	,) 	0.7200		0.7000	1.0	000	15.4496	(82)
Main internal temperature (heating reason) properature during heating presents provestive during heating presents proves	Solar gains Total gains	143.3826 630.0590	282,1505 766,5896	469,3089 938,0010	692.5343 1135.6640	856.4069 1273.2830	880.2044 1271.9969	836.5364 1212.1658	713.3408 1095.4095	548.3836 943.6974	335.9712 757.0770	179.0675 629.8304	117.7348 591.0278	(83) (84)
With Hold and Head Hold Particle 21.0000 (8) This Hold and Head Particle 21.0000 (8) This Hold and Head Particle 31.0 Aug 500 0000 500 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0.0000		1. 6.000.000	(bost)											
tiliakion factor for gains for living area, min (see Table 9a) Apr Apr <td< td=""><td>Temperature du</td><td>ing heat</td><td>ing periods</td><td>in the livi</td><td>ng area fro</td><td>om Table 9.</td><td>Th1 (C)</td><td></td><td></td><td></td><td></td><td></td><td>21.0000</td><td>(85)</td></td<>	Temperature du	ing heat	ing periods	in the livi	ng area fro	om Table 9.	Th1 (C)						21.0000	(85)
au 17.9394 17.5494 17.5376 17.5376 17.5376 17.6344 17.	Utilisation fac	tor for g	gains for 1: Feb	iving area, Mar	nil,m (see Apr	Table 9a) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	18-1
til living area 0.9595 0.9527 0.9185 0.6512 0.7500 0.6236 0.5050 0.5579 0.7504 0.901 0.9568 0.9733 (86) til 1 16.4611 18.7027 19.1311 19.7200 20.2214 20.5758 20.7437 20.7058 20.3902 19.7183 19.9865 18.4555 (87) til rest of house 0.9640 0.9641 0.9901 0.6227 0.6965 0.5759 0.6739 0.6735 0.977 0.5665 (89) til rest of house 0.9640 0.9944 0.9901 0.8227 19.721 18.0792 19.351 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.554 19.555 <td>tau alpha</td> <td>17.4994</td> <td>17.5484 2.1699</td> <td>17.5978</td> <td>17.6944</td> <td>17.6944 2.1796</td> <td>17,6944 2,1796</td> <td>17.6944 2.1796</td> <td>17.6944 2.1796</td> <td>17.6944 2.1796</td> <td>17.6944 2.1796</td> <td>17.6944 2.1796</td> <td>17.6944 2.1796</td> <td></td>	tau alpha	17.4994	17.5484 2.1699	17.5978	17.6944	17.6944 2.1796	17,6944 2,1796	17.6944 2.1796	17.6944 2.1796	17.6944 2.1796	17.6944 2.1796	17.6944 2.1796	17.6944 2.1796	
11 18.4613 18.7087 19.6252 19.6252 19.6252 19.6252 19.6255	util living are	a 0.9695	0.9527	0.9185	0.8512	0.7500	0.6236	0.5050	0.5579	0.7504	0.9003	0.9568	0.9733 ((86)
<pre>till rest of house 0.9640 0.9444 0.9037 0.8227 0.6986 0.5364 0.7789 0.4329 13.0578 0.8750 0.9477 0.9685 (89) IT 2 16.2006 16.6387 17.2774 18.0752 18.7585 13.2022 13.312 13.3514 13.0006 18.0779 17.0552 16.2357 (80) IT 2 16.9991 17.3207 17.8554 18.6198 19.2405 19.6554 19.8301 19.7976 13.4585 18.6318 17.6909 16.3573 (92) 0.0205 (93) It r 16.9991 17.3207 17.8554 18.6198 19.2405 19.6554 19.8301 19.7976 19.4585 18.6318 17.6909 16.3573 (92) 0.0006 10.0279 17.5909 16.5573 (93) It space heating requirement Is pace heating requirement Is pace heating requirement Is 0.000 6.0000 8.0000 8.0000 10.0000 10.0000 10.6000 70.6550 (94) It 1000 10.0000 1.0000 1.0000 1.0000 10.0000 0.0000 0.0000 0.0000 0.0000 10.0000 1.0000 1.0000 (978) Jath Sep State W 1000 4.9000 1.0000 1.0000 1.0000 10.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (978) Jath Sep State W 1000 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (978) Jath Sep State W 1000 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (978) Jath Sep State W 1000 0.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (978) Jath Sep State W 1000 0.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (978) Jath Late State W 1000 0.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (978) Jath Late State W 1000 0.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (978) Jath Sep Conting requirement It space heat from secondary/supplementary system (Table 11) Taction of space</pre>	MIT Th 2	18.4613 19.6226	18.7087 19.6259	19.1531 19.6292	19.7200 19.6355	20.2214	20.5758	20.7437	20.7058	20.3902 19.6355	19.7183 19.6355	18.9886 19.6355	18.4259 19.6355	(87) (88)
If 2 16.2306 16.637 17.2774 18.0792 18.7585 19.2032 19.3812 19.3514 19.0006 18.0979 17.0532 16.2357 60 Aring area fraction 17.2071 17.8954 18.6198 19.2405 19.6554 19.6554 19.776 19.4585 18.6318 17.6909 16.9573 (52) Adjusted MIT 16.9991 17.3207 17.8954 18.6198 19.2405 19.6554 19.8301 19.7976 19.4585 18.6318 17.6909 16.9573 (53) Adjusted MIT 16.9991 17.3207 17.8954 18.6198 19.2405 19.6554 19.8301 19.7976 19.4585 18.6318 17.6909 16.9573 (63) Adjusted MIT 16.9991 0.7953 0.7855 0.6612 0.5176 0.3888 0.4496 0.6666 0.8502 0.9294 0.9556 (93) Attination 0.9491 0.9250 0.4783 18.776 68.0474 483.3824 49.2476 15.0203 64.1000 16.0000 1.0000 1.0000 1.0000 1.0000 1.0000 <t< td=""><td>util rest of ho</td><td>0.9640</td><td>0.9444</td><td>0.9037</td><td>0.8227</td><td>0,6986</td><td>0.5364</td><td>0.3789</td><td>0.4329</td><td>0.6779</td><td>0.8750</td><td>0.9477</td><td>0.9685 (</td><td>(89)</td></t<>	util rest of ho	0.9640	0.9444	0.9037	0.8227	0,6986	0.5364	0.3789	0.4329	0.6779	0.8750	0.9477	0.9685 ((89)
IIT 16,9991 17,3207 17,8954 18,618 19,2405 19,6554 19,8301 19,7976 19,4585 18,6318 17,6909 16,5573 (53) ddjusted MIT 16,9991 17,3207 17,8954 18,618 19,2405 19,6554 19,8301 19,7976 19,4585 18,6318 17,6909 16,9573 (93)	MIT 2 Living area fra	16.2806 action	16.6387	17.2774	18.0792	18.7585	19.2032	19.3812	19,3514	19.0006 fLA =	18.0979 = Living ar	17.0532 ea / (4) =	16.2357 0.3295	(90) (91)
djusted MIT 16.9991 17.3207 17.6954 18.6198 19.2405 19.6554 19.6554 19.7976 15.4585 18.6318 17.6909 16.9573 (83) I. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec tstilisation 0.9491 0.5788 824.8383 904.5371 87.3766 684.0270 15.8000 16.0001 16.000 9.5033 643.6794 585.3357 564.4030 (95) txt temp. 4.3000 19.0001 1.0000	MIT Temperature adj	16.9991 ustment	17.3207	17.8954	18,6198	19.2405	19.6554	19.8301	19.7976	19.4585	18.6318	17.6909	16.9573 0.0000	(92)
1. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec trilisation 0.9491 0.9250 0.8789 0.7965 0.6812 0.5378 0.3388 0.4496 0.6666 0.8502 0.9254 0.9550 (94) stelloss rate 0.9000 4.9000 6.5000 8.9000 11.7000 14.6000 16.4000 14.1000 10.6000 7.1000 4.2000 (96) text loss rate W 2141.3851 202.85867 1910.7990 1620.9407 1257.5019 843.0767 586.6119 893.6104 133.94344 1766.2060 127.4879 (97) pace heating km 0.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (97a) pace heating parce heating 527.0434 808.2929 515.8106 290.2532 0.0000 0.0000 0.0000 0.0000 517.6418 850.2266 1162.9352 (98) 6220.4852 (98) (98) / (4) = 58.5568 (99) traction of space heat from main spacende	adjusted MIT	16,9991	17,3207	17.8954	18.6198	19,2405	19,6554	19.8301	19.7976	19,4585	18,6318	17.6909	16.9573	(93)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec trilisation 0.9491 0.9250 0.8789 0.7865 0.6812 0.5378 0.3888 0.4496 0.6666 0.8502 0.9294 0.9550 (94) isct temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 14.1000 10.6000 7.1000 4.2000 (96) ieat loss rate w 214.1833 2068.5867 1910.7990 1620.9407 1257.5019 843.0767 558.6761 893.6104 1339.4344 766.2060 7.227.4879 (97) ionth fracti 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 1.0000 220.4852 (98) 6220.4	8. Space heatin	ıg require	ement											
Dear FED max ppi may Duil Dui			Pak			Wate		.7]	Puis	Can	Ont	Nov	Dec	
<pre>setury gains 37.5237 (02.03/6 024.3036 304.3271 086.300 13.6000 14.6000 16.6000 16.6000 16.6000 16.6000 16.0000 (10.000 13.0000 199) teat loss rate W 21413853 2088.5867 1910.7990 1620.9407 1257.5019 843.0767 538.6704 566.6119 893.6104 1339.4344 1766.2060 2127.4879 (97) ionch fracti 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (97a) ipace heating kWh 1148.2017 927.0434 806.2929 515.8106 290.2532 0.0000 0.0000 0.0000 0.0000 517.6418 850.2266 1162.9352 (98) gpace heating pr m2 (98) / (4) = 58.5568 (99) cc. Space cooling requirement tot applicable raction of space heat from secondary/supplementary system (Table 11) traction of space heat from main system(s) ifficiency of main space heating system 1 (in %) 175.1000 (206)</pre>	Utilisation	0.9491	reb 0.9250	Mar 0.8789	0,7965	0.6812	0,5378	0.3988	Aug 0.4496	0.6666	0.8502	0.9294	0.9550	(94)
2141.3853 2088.5867 1910,7990 1620.9407 1257.5019 843.0767 538.6704 566.6119 893.6104 1339.4344 1766.2060 2127.4879 (97) 10onth fracti 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 1	Ext temp.	4.3000 W	4.9000	6.5000	8.9000	11,7000	14,6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
pace heating km 1148.2817 927.0434 808.2929 \$15.8106 230.2532 0.0000 0.0000 0.0000 \$17.6418 850.2266 1162.9352 (98) pace heating intervent interve	Month fracti	w 41.3853 1.0000	2088.5867 1.0000	1910.7990 1.0000	1620.9407 1.0000	1257.5019 1.0000	843.0767 0.0000	538.6704 0.0000	566.6119 0.0000	893.6104 0.0000	1339.4344 1.0000	1766.2060 1.0000	2127.4879 (1.0000	(97) (97a)
<pre>pace meacing pr m2 (98) / (4) = 58.5568 (99) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) (98) / (4) = 58.5568 (98) / (4) = 58.5568 (98)</pre>	Space neating) 11	48.2817	927.0434	808.2929	515.8106	290.2532	0.000	0.0000	0.0000	0.0000	517.6418	850.2266	1162.9352 ((98)
<pre>kc. Space cooling requirement kot applicable ka. Energy requirements - Individual heating systems, including micro-CHP vraction of space heat from secondary/supplementary system (Table 11) vraction of space heat from main system(s) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) ifficiency of main space heating system 1 (in %) </pre>	Space heating p	ber m2									(9	8) / (4) =	58.5568	(99)
Not applicable Traction of space heat from secondary/supplementary system (Table 11) Traction of space heat from secondary/supplementary system (Table 11) Traction of space heat from main system(s) Efficiency of main space heating system 1 (in %) 175.1000 (206)														
a. Energy requirements - Individual heating systems, including micro-CHP Craction of space heat from secondary/supplementary system (Table 11) Traction of space heat from main system(s) Efficiency of main space heating system 1 (in %) Craction of space heating system 1 (in %)	Not applicable	ing requi	remerit											
a. Energy requirements - Individual heating systems, including micro-CHP Craction of space heat from secondary/supplementary system (Table 11) Craction of space heat from main system(s) Efficiency of main space heating system 1 (in %) Control of the system 1 (in %)									كالمتكلمات					
Traction of space heat from secondary/supplementary system (Table 11) 0.0000 (201) Traction of space heat from main system(s) 1,0000 (202) ifficiency of main space heating system 1 (in %) 175.1000 (206)	9a. Energy requ	irements	- Individua	al heating s	systems, ind	luding mich	O-CHP							
	Fraction of spa Fraction of spa Efficiency of r	ace heat ace heat main space	from seconda from main sy e heating sy	ary/suppleme /stem(s) /stem 1 (in	entary systematics (em (Table 1)	.)						0.0000 1.0000 175.1000	(201) (202) (206)
					D		105			1	I alabata she	1547 400		_

CALCULA	TION OF I	DWELLIN	G EMISSI	ONS FOR	REGULAT	TIONS CO	MPLIANC	E 09 Ja	n 2014				Page
Efficiency of Space heating	secondary/ requiremen	supplement:	ary heating	system, N								0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	requiremen	t		1000	1.1								
	1148.2817	927.0434	808.2929	515.8106	290.2532	0.0000	0.0000	0.0000	0.0000	517.6418	850.2266	1162.9352	(98)
Space heating	175.1000	175.1000	175.1000	175.1000	175 1000	0 0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
space nearing	655.7862	529.4365	461,6179	294.5806	165.7642	0.0000	0.0000	0.0000	0.0000	295.6264	485.5663	664.1549	(211)
Water heating	requiremen 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	0.0000	(215)
Water heating													
Water heating	requiremen	E											
Efficiency of	215.6094 water beat	190.0536	199.6328	179.0056	175.4545	156.8251	150,6614	165.2566	164,9442	185.6162	196.2097	210.4382	(64)
(217) m	175.1000	175,1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175,1000	175.1000	175,1000	(217)
Fuel for wate	r heating, 1 123.1350	kWh/month 108.5400	114.0107	102.2305	100.2024	89.5632	86.0430	94.3784	94.2000	105 0058	112.0558	120.1817	(219)
Annual totals	kWh/year											1230.3467	(212)
Space heating Space heating	fuel - main fuel - seco	n system ondary										3552.5330 0.0000	(211) (215)
Total electri Slectricity f Fotal deliver	city for the or lighting ed energy for	e above, kv (calculate or all uses	Wh/year ed in Append	lix L)								143.6721 422.8324 5369.5841	(231) (232) (238)
12a. Carbon o	lioxide emis	sions - Ind	lividual hea	cing system	is including	I MICIO-CHP	**********						
Space heating Space heating Water heating	- main syst - secondar (other fue	tem 1 Y						Energy kWh/year 3552.5330 0.0000 1250.5467	Emissi }	ion factor g CO2/kWh 0.5190 0.0000 0.5190	k	Emissions g CO2/year 1843.7646 0.0000 649.0337	(261) (263) (264)
Space and wat	er heating											2492.7983	(265)
Pumps and fan	s							143.6721		0.5190		74.5658	(267)
Total CO2, kg Dwelling Carb	/year on Dioxide 1	Emission Ra	te (DER)					122.0321		0.5150		2786.8141 26.2300	(272) (273)
16 CO2 EMISSI	ONS ASSOCIA	TED WITH AN	PLIANCES AN	D COOKING A	ND SITE-WID	E ELECTRICI	TY GENERATI	ON TECHNOLO	GIES				
DER	-										TED	26.2300	ZCI
Assumed numbe	r of occupan	nts									N	2.7902	
CO2 emission	factor in Ta	able 12 for	electricit	y displaced	from grid						EF	0.5190	1.1.1
202 emissions	from applia	ances, equa	tion (L14)									14.8395	2C2
Total CO2 emi	ssions	ig, equation	in (DIO)									42.8201	ZC4
Residual CO2	emissions of	ffset from	biofuel CHP									0.0000	ZC5
Additional al	lowable elec	ctricity ge	neration, k	Wh/m²/year	alostrisity							0.0000	2C6
Net CO2 emiss	ions	FISEC FION	addicional	arrowante	everticity	Jenerarion						42.8201	ZC8

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

Overall dwelling dimensions

	Area		Store	y height			Volume		
	(m2)			(m)			(m3)		
	41.1800	(1b)	x	2.7000	(2b)	=	111.1860	(1b)	- (3b)
	40.3200	(1c)	x	2.7000	(2c)	=	108.8640	(1c)	- (3c)
	24.7300	(1d)	x	1.9800	(2d)	=	48.9654	(1d)	- (3d)
106.2300								(4)	
	(3	a)+(3	b) + (3c)	+(3d)+(3e)	(3n) =	269.0154	(5)	
	106.2300	Area (m2) 41.1800 40.3200 24.7300 106.2300 (3	Area (m2) 41.1800 (1b) 40.3200 (1c) 24.7300 (1d) 106.2300 (3a)+(3)	Area Store (m2) 41,1800 (1b) x 40.3200 (1c) x 24.7300 (1d) x 106.2300 (3a)+(3b)+(3c)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 40.3200 (1c) x 2.7000 24.7300 (1d) x 1.9800 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 (2b) 40.3200 (1c) x 2.7000 (2c) 24.7300 (1d) x 1.9800 (2d) 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)(3n)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 (2b) = 40.3200 (1c) x 2.7000 (2c) = 24.7300 (1d) x 1.9800 (2d) = 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)(3n) =	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

2. Ventilation rate

			a de la casa de la casa de la c	de a construction de la construcción de la construc									
					main	Se	econdary		other	tota	I m3	per hour	
					heating		heating						
Number of chin	meys				0		0	+	C .	-	0 * 40 =	0.0000	(6a)
Number of oper	flues				0	+	0		0	=	0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans									4 * 10 =	40.0000	(7a)
Number of pass	sive vents										0 * 10 =	0 0000	(7b)
Number of flue	eless gas f	ires									0 * 40 =	0.0000	(7c)
										,	Air changes	per hour	
Infiltration d	ue to chim	nevs, flues	and fans	= (6a) + (6b)	+(7a)+(7b)	+(7c) =				40.0000	/ (5) =	0.1487	(8)
Pressure test		19									A 10.5	Yes	
Measured/desig	m a50											5.0000	
Infiltration r	ate											0 3987	(1.8)
Mumber of oide	a cholesto	a										0.0007	(10)
Number of side	s sneitered	1										2	(19)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0 8500	(20)
Infiltration r	ate adjuste	ed to includ	de shelter d	factor						(21) = (18) 2	c (20) =	0.3389	(21)
				-	44.0	12.7		1.1	4.5			23.0	
	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 rat	e												
	0.4321	0,4236	0.4151	0.3728	0.3643	0.3219	0.3219	0.3135	0.3389	0.3643	0.3812	0.3982	(22b)
Effective ac	0 5933	0 5897	0.5862	0 5695	0 5664	0 5518	0 5518	0 5491	0 5574	0 5664	0 5727	0 5793	(25)

3. Heat losses and heat loss parameter Element AxU Gross Openings NetArea U-value K-value AxK m2 m2 m2 2.2100 W/m2K 1.0000 W/K 2.2100 kJ/m2K kJ/K (26) TER Opaque door IER Opening Type (Uw = 1.40) TER Opening Type (Uw = 1.40) TER Room Window (Uw = 1.70) Heat Loss Floor 1 Wall 1 25.4545 (27) 19.2000 1.3258 1.3100 41.1800 103.3300 2.0852 5.3534 18.5994 1 5918 (27a) 0.1300 (28a) 124.7400 21.4100 (29a) 2.0412 3.7440 4.2016 0.7020 Wall 2 11.3400 20.8000 11.3400 0.1800 (29a) 20.8000 (29a) (30) Wall 3 0 1800 External Roof 1 33.6300 0.1300 1.3100 External Roof 2 5.4000 5.4000 0.1300 (30) External Roof 3 15.5900 15.5900 0.1300 2.0267 (30) 15.5500 252.6800 (26)...(30) + (32) = Total net area of external elements Aum(A, m2) Fabric heat loss, W/K = Sum (A x U) (31) 66.4181 (33) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (User defined value 0.050 \star total exposed area) Total fabric heat loss 250.0000 (35) 12.6340 (36) 79.0521 (37) (33) + (36) = Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ Jul Jan 52.6744 Feb 52.3526 Mar 52.0372 Jun Oct Nov 50.8393 Apr 50.5557 May 50.2785 Aug 48.7492 Sep Dec 51.4255 (38) (38)m 48.9882 48.9882 49.4852 50.2785 Heat transfer coeff Heat transfer coeff 131.7265 Average = Sum(39)m / 12 = 131,4047 131.0893 129.6078 129.3306 128,0402 128.0402 127,8013 128.5372 129.3306 129,8913 130.4775 (39) 129.6064 (39) Jan Feb Apr 1.2201 May 1.2175 Jul Aug 1.2031 Sep 1,2100 Oct Mar Jun Nov Dec HLP HLP (average) 1.2400 1.2370 1.2340 1.2053 1.2053 1.2175 1.2227 1.2283 (40) 1.2201 (40) Days in month 31 28 31 30 31 30 31 31 30 31 30 31 (41) Water heating energy requirements (kWh/year) Assumed occupancy Average daily hot water use (litres/day) 2.7902 (42) 100.4673 (43) Jan Feb Jun Jul Aug Sep Oct Nov Dec Mar Apr May Daily hot water use 110.5140 106.4953 102.4766 163.8890 143.3384 II0.5140 Energy conte 163 perce 106.4953 98.4579 94.4392 90.4205 90.4205 94.4392 102.4766 110.5140 (44) 98.4579 158.7178 (45) 1580.7412 (45) 147.9124 128.9536 123.7341 106.7731 98.9410 113.5362 114.8922 133.8958 146.1577 Energy content (annual) Distribution loss (46)m = 0.15 x (45)m 24.5834 21.5008 22 Total = Sum(45)m = 21.9237 23.8077 (46) 22.1869 19.3430 18.5601 16.0160 14.8411 17.0304 17.2338 20.0844 Water storage loss: Store volume a) If manufacturer declared loss factor is known (kWh/day): 125.0000 (47) 1.2538 (48) Temperature factor from Table 2b Enter (49) or (54) in (55) Total storage loss 20.9878 18.9567 0.5400 (49) 0.6770 (55)

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20.9878

20.9878

20.3108

20.9878 20.3108

20.9878 (56)

20.3108

20.9878 20.3108 20.9878

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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If cylinder contains dedicated solar storage 20.9878 20.9878 (57) 23.2624 (59) 18.9567 21.0112 20.9878 20.9878 23.2624 20.9878 20.3108 20.9878 20.3108 20.9878 20.3108 20.3108 23.2624 23.2624 22.5120 Primary loss 23.2624 22.5120 23,2624 22.5120 23.2624 22.5120
 Filmary loss
 23.2524
 21.012
 23.2624
 22.5120
 23.2

 Total heat required for water heating calculated for each month
 208.1392
 183.3063
 192.1626
 171.7764
 167.96

 Solar input
 0.0000
 0.0000
 0.0000
 0.0000
 0.0000
 167.9842 149.5958 157.7864 157.7149 178.1459 188.9804 0.0000 0.0000 0.0000 0.0000 Solar input (sum of months) = Sum(63)m = 143.1911 202.9680 (62) 0.0000 (63) 0.0000 0,0000 0.0000 Output from w/h 208.1392 183.3063 192.1626 171.7764 167.9842 149.5958 143.1911 57.7864 157.7149 178.1459 188.9804 202.9680 (64) Total per year (kWh/year) = Sum(64)m = 2101.7513 (64) 157.7864 Heat gains from water heating, kWh/month 89.8932 79.6343 84.5 79.9205 84,5810 77.1353 76.5417 69.7603 68.2980 73,1509 72.4598 82.8556 88.1738 (65)

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

Metabolic gains (Table 5), Watts

Jan Feb 139.5100 139.5100 Mar May Jun Jul Aug Sep 139.5100 139.5100 139.5100 139.5100 Jun Jul Oct 139.5100 Nov Dec 139.5100 139.5100 (66) Apr 139.5100 (66)m 139 5100 139.5100
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6. Solar gains

(Jan)			m2	Solar flux Table 6a W/m2	Specif or T	g fic data Table 6b	Specific or Tabl	FF data e 6c	Acce facto Table 6	ss r d	Gains W		
North			1.2	000	10.6334		0.6300	0	.7000	0.77	00	3,8996	(74)
East			18.0	000	19.6403		0.6300	0	.7000	0.77	00	108.0418	(76)
South			1.3	100	26.0000		0.6300	0	,7000	1.00	00	13.5184	(82)
Solar gains Total gains	125.4598 604.1037	246.8817 723.2883	410.6453 871.3049	605.9675 1041.0647	749.3560 1158.1996	770.1788 1153.9388	731,9694 1099,5663	624.1732 998.2094	479.8356 867.1169	293.9748 707.0481	156 6841 599 4145	103.0179 568.2785	(83) (84)

Mean internal temperature (heating ceacon)

// neum incern	ar comperat	are meacri	g beabont				Acres and an	Secolaria.				
Temperature du Utilisation fa	ring heatin ctor for ga	g periods i ins for liv	n the livin	g area from il,m (see 1	Table 9, T Table 9a)	'hl (C)						21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.0030	56.1402	56,2753	56.9185	57.0405	57.6154	57.6154	57.7231	57 3926	57.0405	56.7943	56.5391
alpha	4.7335	4.7427	4.7517	4.7946	4.8027	4.8410	4.8410	4.8482	4 8262	4.8027	4,7863	4.7693
util living ar	ea											
	0.9984	0,9959	0.9865	0.9480	0.8429	0.6647	0.5024	0.5695	0.8376	0.9779	0,9966	0.9988 (86)
MIT	19.6112	19.7857	20,0934	20.4926	20.8022	20.9541	20.9904	20.9830	20.8595	20,4291	19,9459	19.5841 (87)
Th 2	19.8881	19.8905	19.8929	19.9040	19.9061	19.9158	19.9158	19.9176	19.9120	19.9061	19.9019	19.8975 (88)
util rest of h	ouse											
	0.9978	0.9945	0.9816	0.9288	0.7896	0.5701	0.3837	0.4451	0.7614	0.9664	0.9951	0,9984 (89)
MIT 2	18.0401	18.2965	18,7446	19.3168	19,7183	19.8866	19.9124	19,9109	19.8008	19.2406	18.5391	18.0070 (90)
Living area fr	action								fLA =	Living area	/ (4) =	0,3295 (91)
MIT	18.5577	18.7872	19.1890	19.7042	20.0754	20,2383	20.2676	20.2641	20,1496	19.6322	19.0026	18.5266 (92)
Temperature ad	justment											0.0000
adjusted MIT	18.5577	18.7872	19.1890	19.7042	20.0754	20.2383	20.2676	20.2641	20.1496	19.6322	19.0026	18.5266 (93)

8. Space heating requirement

Mar Apr 0.9245 962.4931 May 0.7988 925.2160 Jul Aug 0.4863 485.4718 16.4000 Sep 0.7803 676.6459 Oct Nov Dec Jan Feb Jun 0.9925 717.8422 4.9000 0.9976 (94) 566.9253 (95) 4.2000 (96) 0.9774 851.6158 0.5998 0.4231 465.1891 0.9626 0.9968 0.9934 Utilisation 595.4612 7.1000 Useful gains 602.1920 Ext temp. 4.3000 Heat loss rate W 14,6000 6.5000 8.9000 11.7000 16.6000 14 1000 10.6000 1878.1220 1824.8413 1663.3891 1400.3057 1083.2001 Month fracti 1.0000 1.0000 1.0000 1.0000 1.0000 469.5957 777.6021 1168.1355 1546.0470 1869.2974 (97) 721,9356 493.8366 0.0000 1.0000 1.0000 1.0000 (97a) 0.0000 0.0000 1.0000 0.0000 Space heating kWh 0.0000 949,2920 743.9034 603.9593 315.2251 117.5402 0.0000 0.0000 0.0000 362.7440 684.4218 968.9649 (98) 4746.0506 (98) 44.6771 (99) Space heating (98) / (4) = Space heating per m2

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)

 Praction of space heat from main system(s)

 Efficiency of main space heating system 1 (in %)

 Efficiency of secondary/supplementary heating system, %

 Space heating requirement

 0.0000 (202)

 5075.9900 (211)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heatin	g requireme	nt											
	949.2920	743.9034	603,9593	315.2251	117.5402	0.0000	0.0000	0.0000	0.0000	362.7440	684.4218	968.9649	(98)
Space heatin	g efficienc	y (main heat	ting 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 heatin	g fuel (mai	n heating s	ystem)										
	1015.2855	795.6186	645.9458	337.1391	125.7115	0.0000	0.0000	0.0000	0.0000	387,9615	732.0020	1036.3261	(211)
Water heatin	g requireme	nt.											
	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 heatin	g												
Water heatin	g requireme	nt											
	208.1392	183.3063	192.1626	171.7764	167.9842	149.5958	143.1911	157.7864	157,7149	178.1459	188.9804	202.9680	(64)
Efficiency o	f water hea	ter										79 8000	(216)
(217)m	88.3692	88.1630	87.6628	86.4131	83.8827	79.8000	79.8000	79.8000	79.8000	86,6724	87.9484	88.4461	(217)
Fuel for wat	er heating,	kWh/month											
	235.5336	207.9176	219.2064	198.7851	200.2608	187.4635	179.4375	197.7273	197.6378	205.5394	214.8765	229.4822	(219)
Water heatin	g fuel used											2473.8677	(219)
Annual total	s kWh/year												
Space heatin	g fuel - ma	in system										5075.9900	(211)
Space heatin	g fuel - se	condary										0.0000	(215)
Electricity	for pumps as	nd fans:											
central he	ating pump											30,0000	(230c)
main heati	ng flue fan											45.0000	(230e)
Total electr	icity for the	he above, kl	Wh/year									75.0000	(231)
Electricity	for lighting	g (calculate	ed in Append	lix L)								422.8324	(232)
Total delive	red energy	for all uses	5									8047.6900	(238)

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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	5075.9900	0.2160	1096.4138	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2473.8677	0.2160	534_3554	(264)
Space and water heating			1630.7693	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Total CO2, kg/m2/year			1889.1443	(272)
Emissions per m2 for space and water heating			15.3513	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0658	(272b)
Emissions per m2 for pumps and fans			0.3664	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.3513 * 1.55) + 2.065	3 + 0.3664, rounded to 2 d.p.		26.2300	(273)

CALCULATION DETAILS for survey reference no 'ASHP' 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

***************************************				1.1.1							
		Area		Store	y height			Volume			
		(m2)			(m)			(m3)			
Ground floor		41,1800 (1	.b)	x	2.7000	(2b)	÷.,	111.1860	(1b)	- (3)	o)
First floor		40.3200 (1	.c)	30	2.7000	(2c)	=	108.8640	(1c)	- (30	2)
Second floor		24.7300 (1	(b.	×	1.9800	(2d)	=	48.9654	(1d)	- (30	d)
Total floor area TFA = $(1a) + (1b) + (1c) + (1d) + (1e) (1n)$	106.2300								(4)		
Dwelling volume		(3a)	+(3b)	+ (3c)	+(3d)+(3e)	(3n)	5	269.0154	(5)		
Dwelling volume	106.2300	(3a)	+(3b)	+ (3c)	+(3d)+(3e)	(3n)	5	269.0154	(5)		

2. Ventilation rate

					main heating	s	econdary heating		other	total	m	per hour	
Number of chin	mevs				0	+	0	+	0	*	0 * 40 =	0.0000	(6a)
Number of oper	flues				0	+	0	+	0	-	0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans							- C		4 * 10 =	40.0000	(7a)
Number of nase	tive vents	and a									0 * 10 =	0.0000	(7b)
Number of flue	eless gas f	ires									0 * 40 =	0,0000	(7c)
										А	ir changes	per hour	
Infiltration of Pressure test Measured/desig Infiltration of Number of side	lue to chim n q50 cate es sheltered	neys, flues 1	and fans	= (6a)+(6b)	+ (7a) + (7b) +	+(7c) =				40,0000	/ (5) =	0.1487 Yes 5.0000 0.3987 2	(8) (18) (19)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration n	ate adjuste	ed to includ	de shelter i	factor						$(21) = (18) \times$	(20) =	0.3389	(21)
	Jan	Feb	Mar	Apr	May	Jun		Allo	Sen	Det	Nov	Dec	
Wind sneed	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)
Adi infilt rat	P. 2750	1.1500	1.2250	1,1000	2.0750	0.0000	5.5500	0.5250	2.0000	2.0/30			
ing many for	0.4321	0.4236	0 4151	0 3728	0 3643	0 3219	0.3219	0 3135	0 3389	0.3643	0.3812	0.3982	(22b)
REFORTING TO	0 5033	A 5007	0 5960	A FEAF	DECCA	0 5510	0 5519	0 5491	0 6574	D SEEA	0 5727	0 5793	1251

Plamant				Green	Opening	No	*****	11-112100		. 11. 1	-walne	A v F	
Frement				GLOSS	opening	5 140	ma	W/m2V		lv 1	7/m28	LT/W	1.0
Opening These	1111 - 1 6	0)		1112	1112	10	2000	1 5020	20 07	100	io/mar.	KU/K	1221
Opening Type	10W = 1.0	07				13	2100	1,3030	20.0	00			(26)
Opening Type	/10 1 6	201					1.2100	1 6039	1.04				12721
Upening Type .	5 (UW = 1.6	07				41	1 1800	1.5056	7.4	24			(293)
Wall 1				174 7400	27 410	0 103	2300	0.1000	24.70	24			(200)
Wall 1				11 7400	21.410	0 103	3,3300	0.2400	23.7	000			(290)
Wall 2				11.3400		11	8000	0.3200	3.6.	00			(292)
Wall 5				20.8000	1 210	0 20	2200	0.1500	3.1.	.00			(200)
External Roof	1			53.6300	1.310	U 34	1000	0.1300	4.0	20			(30)
External Roof	2			5.4000		1.	5,4000	0.1500	2 44	120			(30)
Excernal ROOF	2			10, 5500		12	5,5500	0.1000	2.43				(30)
Total net area	or extern	Cur () at II	Aum (A, m2)			204	(20)	1201 - 1201	PA 4*	160			(31)
rabiic neat it	085, W/K =	Sum TA X UI					(20)	(30) + (32)	- 04.4	65			1331
Thermal mass p Thermal bridge Total fabric b Ventilation he	parameter (es (Default heat loss eat loss ca	TMP = Cm / value 0.15	TFA) in kJ/ 0 * total e	m2K exposed area 1 = 0.33 x	a) (25) m x (5)					(33)	+ (36) =	100.0000 37.9020 122.3789	(35) (36) (37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.6744	52.3526	52.0372	50.5557	50.2785	48.9882	48.9882	48.7492	49.4852	50.2785	50.8393	51.4255	(38)
Heat transfer	coeff												
	175.0533	174.7315	174.4161	172.9346	172.6574	171.3671	171.3671	171.1281	171.8641	172.6574	173.2182	173.8044	(39)
Average = Sum	(39)m / 12	=										172.9333	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP HLP (average)	1.6479	1.6448	1.6419	1.6279	1,6253	1.6132	1.6132	1.6109	1.6178	1.6253	1,6306	1.6361 1.6279	(40) (40)
Days in month		2.0		2.0		2.0		22	20	2.2	70		1021
	31	20	31	30	51	30			30				
4. Water heati	ing energy	requirement	s (kWh/year	;)									
				2012101101	A CONTRACTOR OF THE OWNER OWNE								

Assumed occupancy Average daily hot water use (litres/day) 2.7902 (42) 100.4673 (43) Jan Jul Oct Nov Feb Mar Apr May Jun Aug Sep Dec Daily hot water use 110.5140 106.4953 102.4766 Energy conte 163.8890 143.3384 147.9124 Energy content (annual) 102.4766 106.4953 133.8958 146.1577 Total = Sum(45)m = 94.4392 123.7341 98.4579 90.4205 90.4205 94,4392 98.4579 110.5140 (44) 158.7178 (45) 1580.7412 (45) 128.9536 106.7731 98.9410 113.5362 114.8922 Energy content (annual) 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 (56) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 If cylinder contains dedicated solar storage 0,0000 0,0000 0.0000 Primary loss 0,0000 0.0000 0.0000 0.0000.0 0.0000 (57) 0.0000 (59) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Heat gains from water heating, kWh/month

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CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

21.0000 (85)

34.8264 30.4594 31.4314 27.4026 26.2935 22.6893 21.0250 24.1264 24.4146 28 4528 31 0585 33 7275 (65)

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

Metabolic gains (Table 5), Watts
 Metabolic gains (Table 5), Watts
 Mar
 Apr
 May
 Jun
 Jul
 Aug
 Sep

 (66)m
 139.5100
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 139.5100
 139.510
 139.510
 15.5763

 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
 266.0241
 268.7846
 261.8282
 247.0189
 23.249
 210.751
 199.0174
 196.2569
 203.2133

 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
 Oct 139.5100 Now Dec 139.5100 139-5100 (66) 19.7777 23.0835 24.6080 (67) 199 0174 196.2569 203.2133 218.0225 236.7166 254.2864 (68) 36,9510 (69) 36,9510 36 9510 0.0000 0.0000 0.0000 (70)
 Pumps, fans
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 0. Total internal gains 401,6293 400,2296 386.2220 363,0240 338,3057 315,3837 301,0579 305,1430 317,5518 340,8964 367,7900 389,0800 (73)

6 Solar maine	

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W	
		W/m2	or Table 6b	or Table 6c	Table 6d		
North	1.2000	10.6334	0.7200	0.7000	0.7700	4.4567 ((74)
East	18.0000	19.6403	0.7200	0.7000	0.7700	123.4763 ((76)
South	1.3100	26.0000	0.7200	0.7000	1.0000	15.4496 ((82)

713.3408 548.3836 143.3826 282.1505 469.3089 692.5343 856.4069 880.2044 836.5364 713.3408 545.0119 682.3801 855.5308 1055.5584 1194.7126 1195.5880 1137.5943 1018.4838 Solar gains 335,9712 179.0675 117,7348 (83) Total gains 865.9354 676.8675 546.8575 506.8148 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, ni1,m (see Table 9a) Jan Feb Mar Apr May 16.8568 16.8878 16.9184 17.0633 17.0907 Jun Jul Aug 17.2194 17.2194 17.2434 + ===

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	16.8568	16.8878	16.9184	17.0633	17.0907	17.2194	17.2194	17.2434	17.1696	17.0907	17.0354	16.9779
alpha	2.1238	2.1259	2.1279	2.1376	2.1394	2.1480	2.1480	2.1496	2.1446	2.1394	2.1357	2.1319
util living a	rea											
	0.9769	0,9623	0.9318	0.8700	0.7751	0.6524	D.5356	0.5914	0_7811	0.9189	0.9671	0.9802 (86)
MIT	17.5705	17,9040	18.5115	19.3059	20.0186	20.5410	20.7902	20.7319	20.2627	19.3053	18.2912	17.5122 (87)
Th 2	19.5784	19,5806	19.5828	19,5929	19.5948	19.6037	19.6037	19.6053	19.5003	19.5948	19.5910	19.5870 (88)
util rest of	house											
	0.9727	0.9553	0_9187	0.8436	0.7251	0.5641	0.4033	0.4619	0.7114	0.8969	0.9599	0.9765 (89)
MIT 2	16,5025	16.8338	17.4334	18.2096	18.8775	19.3384	19,5227	19.4922	19.1237	18.2289	17.2283	16.4500 (90)
Living area f	raction								£LA =	Living area	(4) =	0.3295 (91)
MIT	16.8544	17,1864	17.7886	18.5708	19.2535	19,7347	19.9403	19.9006	19.4990	18.5836	17.5785	16.8000 (92)
Temperature a	djustment											0.0000
adjusted MIT	16.8544	17,1864	17.7886	18.5708	19,2535	19,7347	19,9403	19.9006	19.4990	18.5836	17.5785	16.8000 (93)

8. Space heating requirement

May 0.7108 849.1961 Aug 0.4929 501.9699 Sep 0.7052 610.6848 Jan Feb Mar Jun Jul Oct. Nov Apr Dec Utilisation 0.9606 Useful gains 523.5258 0.9657 (94) 489.4358 (95) 4.2000 (96) 0.9386 0.8964 766.8872 0.8195 865.0056 0.5735 0.4386 0.8755 0 9448 516.6823 LAT temp. 4.3000 Heat loss rate W 16.4000 4.9000 6.5000 8.9000 11.7000 14.6000 16,6000 14.1000 10.6000
 Heat loss rate W
 2197.6890
 2146.8229
 1968.9080
 1672.4209
 1304.1608

 Month fracti
 1.0000
 1.0000
 1.0000
 1.0000

 Space heating kWh
 1245.5774
 1012.2459
 894.3035
 581.3390
 338.4937
 572.4132 599.0529 927.8878 1378.4225 1815.0694 2189.9278 (97) 0.0000 1.0000 1.0000 (97) 879.9140 1.0000 1.0000 0.0000 0.0000 0.0000 1.0000 1.0000 (97a) 0.0000 0.0000 0 0000 0.0000 584.6482 934.8387 1265.1660 (98) 6856.6125 (98) 64.5450 (99) Space heating (98) / (4) = Space heating per m2

8c. Space cooling requirement Calculated for tune. Buly and hus

carcaracea TOI	nome, nory	and August	- Dec 10010	100								
	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	e W											
	0.0000	0.0000	0.0000	0.0000	0.0000	1610.8506	1268.1164	1300.5738	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6544	0.7193	0.6778	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1054 0981	912.1151	881.4853	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0 0000	0.0000	0.0000	1485.8107	1416.7649	1282.7213	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	310.8331	375.4595	298.5196	0 0000	0.0000	0.0000	0.0000 (104)
Space cooling												984.8121 (104)
Cooled fractio	on								£C =	cooled area	a / (4) =	1.0000 (105)
Intermittency	factor (Tab	le 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	77.7083	93.8649	74.6299	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												246.2030 (107)
Space cooling	per m2											2.3176 (108)
Energy for spa	ace heating											64.5450 (99)
Energy for spa	ace cooling											2.3176 (108)
Total												66.8626 (109)
Dwelling Fabri	ic Energy Ef	ficiency (I	FEE)									66.9 (109)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

CALCULATION DETAILS for survey reference no 'ASHP' 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

ey height Volume
(m) (m3)
2.7000 (2b) = 111.1860 (1b) - (3b)
2.7000 (2c) = 108.8640 (1c) - (3c)
1.9800 (2d) = 48.9654 (1d) - (3d)
(4)
$(3d) + (3d) + (3e) \dots (3n) = 269.0154 (5)$
2,7000 (2c) = 108.8640 (1c) - 1.9800 (2d) = 48.9654 (1d) - (4) (+(3d)+(3e)(3n) = 269.0154 (5)

2. Ventilation rate

z. ventilation	Lace												
	**********	**********			main		econdary		other	total	m3	per hour	
					heating	1.00	heating					Pro deser	
Number of chim	nevs				0	+	0	+	0		0 * 40 =	0.0000	(6a)
Number of open	flues				0	+	0	¥	0	-	0 * 20 =	0.0000	(6b)
Number of inte	rmittent fa	ans									4 * 10 =	40.0000	(7a)
Number of pass	ive vents										0 * 10 =	0.0000	(7b)
Number of flue	less gas f	ires									0 * 40 =	0.0000	(7c)
										A	ir changes	per hour	
Infiltration d	ue to chim	neys, flues	and fans	= (6a) + (6b)	+(7a)+(7b)	+(7c) =				40.0000	/ (5) =	0.1487	(8)
Pressure test												Yes	
Measured/desig	m q50											5.0000	
Infiltration r	ate											0.3987	(18)
Number of side	s sheltered	d										2	(19)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration r	ate adjust	ed to includ	le shelter i	factor						$(21) = (18) \times$	(20) =	0.3389	(21)
							2.						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1.2.2.
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 rat	e												1000
	0.4321	0.4236	0.4151	0.3728	0.3643	0.3219	0.3219	0.3135	0.3389	0.3643	0.3812	0.3982	(22b)
Efforting an	A E033	A EPOT	0 5963	A FEGE	A ECCA	0 6610	0 5510	0 5401	0 5574	0 5664	0 5707	0 5793	(25)

3. Heat losses and heat loss parameter A x U W/K 2.2100 Element Gross Openings NetArea U-value K-value AXK m2 m2 2.2100 W/m2K 1.0000 kJ/m2K kJ/K m2 (26) TER Opaque door TER Opening Type (Uw = 1.40) TER Room Window (Uw = 1.70) Heat Loss Floor 1 19.2000 1.3258 25.4545 (27) 1,3100 41,1800 103,3300 1.5918 2.0852 5.3534 18.5994 (27a) (28a) 124.7400 21.4100 0.1800 Wall 1 (29a) 2.0412 3.7440 4.2016 11.3400 20.8000 Wa11 2 11 3400 0 1800 (29a) 20.8000 0.1800 Wall 3 (29a) (30) External Roof 1 1.3100 33.6300 External Roof 2 5.4000 5.4000 0.1300 0.7020 (30) External Roof 3 15.5900 15 5900 0.1300 2.0267 (30) Total net area of external elements Aum(A, m2) 252.6800 (26)...(30) + (32) = 66.4181 Fabric heat loss, W/K = Sum (A x U) (33) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K Thermal bridges (User defined value 0.050 \star total exposed area) 250.0000 (35) 12.6340 (33) + (36) =Total fabric heat loss 79.0521 (37) Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$ Jul Mar Jun Jan 52.6744 Feb Apr 50.5557 May Aug 48.7492 Sep 49.4852 Oct Nov 50.8393 Dec 51,4255 (38) 52.3526 52.0372 50.2785 50.2785 (38)m 48 9882 48.9882 Heat transfer coeff 131.7265 131.4047 131.0893 129.6078 129.3306 128.0402 128.0402 127.8013 128.5372 129.3306 129.8913 130.4775 (39) 129.6064 (39) Average = Sum(39)m / 12 = Dec 1.2283 (40) 1.2201 (40) Jan Aug 1.2031 Sep Feb Jul Oct Not Apr 1.2201 May 1,2175 1.2100 1.2175 1.2227 1.2370 1,2340 1.2053 1.2053 1.2400 HLP HLP (average) Days in month 31 31 30 31 (41) 31 31 30 31 30 31 30 28

***********	 		**************	******	a sina sana sana sana s
		the second s			

4. Water heating energy requirements (kWh/year) 2.7902 (42) 100.4673 (43) Assumed occupancy Average daily hot water use (litres/day) Mar Oct Nov Jan Feb May Jun Jul Aug Sep Dec Apr Daily hot water use 110.5140 Energy conte 163.8890 Energy content (annual) 106.4953 102.4766 106.4953 110,5140 (44) 98 4579 94.4392 90.4205 90.4205 94.4392 98.4579 102.4766 158.7178 (45) 1580.7412 (45) 143.3384 147.9124 128.9536 123.7341 106.7731 98.9410 113.5362 114.8922 133.8958 146.1577 Total = Sum(45)m = Distribution loss $(46)m = 0.15 \times (45)m$ 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 (56) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 If cylinder contains dedicated solar storage 0.0000 0.0000 0.0000 Primary loss 0.0000 0.0000 0.0000 0.0000 0.0000 (57) 0.0000 (59) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Heat gains from water heating, kWh/month

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CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

21.0000 (85)

34.8264 30.4594 31.4314 27.4026 26.2935 22 6893 21 0250 24 1264 24 4146 28 4528 31 0585 33.7275 (65)

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

Metabolic gains (Table 5), Watts Jan Feb (66)m 139.5100 139.5100
 Metabolic gains (Table 5), Watts
 Mar
 Apr
 May
 Jun

 (66)m
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 Appliances gains (calculated in Appendix L, equation L13 or L13 or L13a), also see Table 5
 16,9510
 36,9510
 36,9510
 32,9249
 210,7551
 15

 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
 36,9510
 36,9510
 Aug 139.5100 Jun Jul 139.5100 139.5100 Sep 139.5100 Oct Nov 139.5100 139.5100 139,5100 (66) 8,9281 11.6051 15.5763 19 7777 23.0835 24 6080 (67) le 5 199.0174 196.2569 203.2133 218.0225 236.7166 254 2864 (68) 36.9510 36.9510 36 9510 36.9510 36.9510 36 9510 (69) 0.0000 0.0000 0.0000 0.0000 (70) 0.0000 0.0000 Losses e.g. evaporation (negative values) (Table 5) -111.6080 Losses e.g. evaporation integration (11.6080 -111.6080 -32,4280 33.9092 38.2431 43.1368 45.3327 (72) 305 1430 317 5518 340 8964 367 7900 389 0800 (73)

6. Solar gains

	41022544602												
[Jan]			A	rea m2	Solar flux Table 6a W/m2	Specif or T	g fic data Table 6b	Specific or Tabl	FF data e 6c	Acce facto Table 6	ss r d	Gains W	
North			1.2	000	10.6334		0.6300	0	.7000	0.77	00	3.8996	(74)
East			18.0	000	19.6403		0.6300	0	. 7000	0.77	00	108.0418	(76)
South			1.3	100	26.0000		0.6300	0	,7000	1.00	00	13.5184	(82)

Solar gains	125.4598	246.8817	410.6453	605.9675	749.3560	770.1788	731,9694	624.1732	479.8356	293.9748	156.6841	103.0179	(83)
Total gains	527.0891	647,1113	796.8672	968.9916	1087.6617	1085.5625	1033.0272	929.3162	797.3874	634.8711	524.4740	492.0980	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, nil,m (see Table 9a) Jan Feb Mar Apr May Jun Mar Aug Jul

OLTITORTION TO	accor tor de	THE TOT TT	ing area, i	TTT' IN LOCE	addre stal							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.0030	56.1402	56.2753	56.9185	57.0405	57.6154	57.6154	57.7231	57,3926	57.0405	56.7943	56.5391
alpha	4.7335	4.7427	4.7517	4.7946	4.8027	4.8410	4_8410	4.8482	4.8262	4.8027	4,7863	4.7693
util living an	rea											
and a second second	0.9991	0.9975	0.9906	0.9595	0.8665	0.6961	0.5318	0.6055	0,8693	0.9855	0.9981	0.9994 (86)
MIT	19,5446	19.7205	20.0322	20.4426	20.7727	20.9441	20.9877	20.9779	20.8305	20.3717	19.8814	19.5180 (87)
Th 2	19.8881	19.8905	19.8929	19.9040	19.9061	19.9158	19.9158	19.9176	19.9120	19,9061	19.9019	19.8975 (88)
util rest of 1	nouse											
	0.9988	0.9966	0.9871	0.9438	0.8174	0.6009	0.4077	0.4762	0.8003	0.9776	0.9973	0.9992 (89)
MIT 2	18.5600	18.7374	19.0490	19,4573	19.7556	19.8909	19.9128	19.9115	19.8168	19.3970	18.9073	18.5407 (90)
Living area for	raction								fLA =	Living area	/ (4) =	0.3295 (91)
MIT	18.8844	19.0614	19.3730	19.7819	20.0907	20,2379	20.2670	20.2628	20.1508	19.7181	19.2283	18.8627 (92)
Temperature ad	ljustment											0.0000
adjusted MIT	18.8844	19.0614	19.3730	19.7819	20.0907	20.2379	20.2670	20.2628	20.1508	19.7181	19.2283	18.8627 (93)

8. Space heating requirement

Aug 0.5193 482.6249 Apr 0.9416 912.4223 May Jan Feb Mar Jun Jul Sep Oct Nov Dec 0.8179 652.1604 14.1000 0.9757 619.4700 10.6000 0,9965 0.9989 (94) 491.5348 (95) 4.2000 (96) Utilisation 0.9984 Useful gains 526.2494 0.9956 0.9849 784.8085 0.8267 899.1882 0.6309 0.4490 522.6608 Ext temp. 4.3000 Heat loss rate W 14,6000 16.6000 16,4000 4.9000 6.5000 8.9000 11.7000 1921.1508 Month fracti 1.0004 469.5171 777.7502 721.8827 493.6752 1085.1721 1179.2507 1575.3572 1913.1551 (97) 1860.8682 1687.5078 1410.3838 0.3838 Space heating kWh 1.0000 1.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (97a) 1.0000 0.0000 0.0000 416.4768 757.9414 1057.6855 (98) 1037.8067 817.5419 671.6083 358.5323 138.3721 0.0000 0.0000 0.0000 5255.9649 (98) 49.4772 (99) Space heating (98) / (4) = Space heating per m2

8c. Space cooling requirement

Calculated for	June, July	y and August.	See Table	e 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	1203.5781	947.4977	971.2897	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8751	0.9298	0.8988	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1053.3047	881.0232	873.0276	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7174	1296.9138	1180.4683	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	220.6172	309.4226	228.7358	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												758,7756 (104)
Cooled fractic	m								fC =	cooled area	/ (4) =	1,0000 (105)
Intermittency	factor (Tal	ble 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	55.1543	77.3556	57 1840	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												189.6939 (107)
Space cooling	per m2											1.7857 (108)
Energy for spa	ice heating											49.4772 (99)
Energy for spa	ce cooling											1.7857 (108)
Total												51.2629 (109)
Target Fabric	Energy Eff:	iciency (TFEE	S)									59.0 (109)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

Storey height	Volume
(m)	(m3)
x 2.7000 (2b)	= 111.1860 (1b) - (3b)
x 2.7000 (2c)	= 108.8640 (1c) - (3c)
x 1,9800 (2d)	= 48.9654 (1d) - (3d)
	(4)
+(3c)+(3d)+(3e) . (3n)	= 269.0154 (5)
	Storey height (m) x 2.7000 (2b) x 2.7000 (2c) x 1.9800 (2d) +(3c)+(3d)+(3e) (3n)

2. Ventilation rate

					main	S	econdary		other	tota	1 m.	3 per hour	
Number of chir	mevs				neacing	+	neacing 0	+	0		0 * 40 =	0.0000	(6a)
Number of oper	flues				0	+	0	+	0		0 * 20 =	0.0000	(6b)
Number of inte	ermittent f:	ane					2		-		0 * 10 =	0.0000	(7a)
Number of pass	sive vents										0 * 10 =	0.0000	(7b)
Number of flue	eless gas f	ires									0 * 40 =	0.0000	(7c)
											Air changes	s per hour	
Infiltration of Pressure test	due to chim	neys, flues	and fans	= (6a)+(6b)+(7a)+(7b)	+(7c) =				0.0000	(5) =	0.0000 Yes	(8)
Measured/desig	m q50											5,0000	12.05
Number of side	rate es sheltere	d										0.2500	(18)
Shelter factor									(20) = 1	- 10.075 x	(19)] =	0.8500	(20)
Infiltration a	rate adjust	ed to includ	de shelter i	factor						(21) = (18)	x (20) =	0.2125	(21)
	Tan	Feb	Mar	Apr	Maty	Tun	Tul	Aug	Sen	Det	Nov	Dec	
Wind speed	4 3000	4 2000	4 1000	3.9000	3 9000	3.4000	3,6000	3,4000	3,4000	3.7000	3,6000	4.0000	(22)
Wind Factor	1 0750	1 0500	1 0250	0 9750	0 9750	0 8500	0.9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rat	:e	1.0500	1.0250	0.0750	0.5150	0.0000	0.5000	0.0500	0.0500	0,5250	0.0000	1.0000	1224/
	0.2284	0.2231	0.2178	0_2072	0.2072	0,1806	0.1913	0_1806	0.1806	0.1966	0.1913	0.2125	(22b)
Mechanical ext	tract ventil	lation - dec	centralised										12.1
If mechanical	ventilation	n:										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)

North Assess and back from assession

3. Heat loss	ses and neat 1	loss paramet	er	Land all a col	2002.000.000	ann an	ascentice in	ana an					
Element				Gross	Openings	Net	Area	U-value	AxU	K	-value	A×K	5
				m2	m2		m2	W/m2K	W/K	k	J/m2K	kJ/K	
Opening Type	e 1 (Uw = 1.60))				19	2000	1.5038	28.8722				(27)
Opening Type	e 2					2	2100	3.0000	6.6300	6. I			(26)
Opening Type	e 3 (Uw = 1.60))				1	.3100	1.5038	1.9699	be i			(27a)
Heat Loss FI	loor 1					41	1800	0.1800	7.4124				(28a)
Wall 1			1	24.7400	21.4100	103	.3300	0.2400	24.7992				(29a)
Wall 2				11.3400		11	.3400	0.3200	3.6288	r i			(29a)
Wall 3				20.8000		20	8000	0-1500	3.1200	Real Provide State			(29a)
External Roo	of 1			33.6300	1.3100	32	3200	0.1500	4.8480	61			(30)
External Roc	of 2			5.4000		5	4000	0.1300	0.7020				(30)
External Roo	of 3			15.5900		15	5900	0.1600	2.4944				(30)
Total net an	rea of externa	l elements	Aum (A, m2)			252	6800						(31)
Fabric heat	loss, $W/K = S$	Sum $(A \times U)$					(26) (30) + (32) =	84.4769				(33)
Thermal mass	s parameter (1	MP = Cm / T	TA) in kJ/m	12K								100,0000	(35)
Thermal brid	iges (Default	value 0.150	* total ex	posed area								37,9020	(36)
Total fabric	c heat loss									(33)	+ (36) =	122.3789	(37)
Ventilation	heat loss cal	culated mon	thly (38)m	= 0.33 x (3	25)m x (5)								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.3875	44.3875	44.3875	44,3875	44,3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	(38)
Heat transfe	ar cooff												

Heat transfer coeff 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 166.7664 (39) Average = Sum(39)m / 12 = 166.7664 (39) Jul 1.5699 Dec 1.5699 (40) 1.5699 (40) Jan Feb Mar Apr 1.5699 May 1.5699 Jun 1.5699 Aug Sep 1.5699 1.5699 Oct 1.5699 Nov HLP HLP (average) 1.5699 1.5699 1.5699 1.5699 Days in month

31 28 31 30 31 30 31 31 30 31 30 31 (41)

4. Water heat	ing energy	requirement	s (kWh/year)									
Accumed occurs			*********			*******	**********	*******				2 7902	(42)
Average daily	hot water	use (litres	(day)									100.4673	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot wat	er use												
	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106,7731	98,9410	113.5362	114 8922	133.8958	146.1577	158.7178	(45)
Energy conten	t (annual)									Total = S	um(45)m =	1580.7412	(45)
Distribution	loss (46) m	n = 0.15 x (45)m										
	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17-0304	17.2338	20.0844	21.9237	23.8077	(46)
Water storage	loss:												
Store volume												125.0000	(47)
a) If manufa	cturer decl	ared loss f	actor is know	own (kWh/d	ay):							1.7000	(48)
Temperature	factor from	Table 2b		and the second second								0.5400	(49)

21.0000 (85)

Enter (49) or (54) in (55) Total storage loss 0 9180 (55) 28.4580 27.5400 28.4580 27.5400 28,4580 (56) 25.7040 28.4580 27.5400 28.4580 27,5400 28.4580 28.4580 If cylinder contains dedicated solar storage 28.4580 25.7040 28.4580 Primary loss 23.2624 21.0112 23.262 27.5400 27.5400 28.4580 28.4580 27.5400 28,4580 27.5400 28.4580 28,4580 (57) 21.0112 Primary loss 23.2624 (59) 22,5120 23.2624 22.5120 23.2624 22.5120 23 2624 22.5120 23.2624 23.2624 Total heat required for water heating calculated for each month 215.6094 199.6328 175.4545 185.6162 196.2097 190.0536 179.0056 156 8251 150 5614 165.2566 164.9442 210,4382 (62) 0.0000 0.0000 (63) 0.0000 0.0000 0.0000 0.0000 Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Solar input (sum of months) = Sum(63)m = Output from w/h 210.4382 (64) 2189.7072 (64) 2190 (64) 196.2097 215.6094 190.0536 199.6328 179.0056 175.4545 156.8251 150,6614 165.2566 164.9442 185.6162 Total per year (kWh/year) = Sum(64)m = RHI water heating demand Heat gains from water heating, kWh/month 95.8694 85.0322 90.5572 82,9187 82,5179 75.5437 74.2742 79.1271 78,2432 85.8967 88.6390 94.1500 (65)

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

Metabolic gains (Table 5), Watts
 Jan
 Feb
 Mar
 Apr
 May
 Jun

 (66)m
 167.4120
 167.4120
 167.4120
 167.4120
 167.4120
 167.4120

 Lighting gains
 (calculated in Appendix L, equation L9 or 19a), also see Table 5
 59.8563
 53.1638
 43.2357
 32.7322
 24.4677
 20.6567
 Jul Aug Sep Oct Nov Dec 167,4120 167,4120 167 4120 167 4120 (66) 167 4120 167.4120 29,0127 22,3203 38.9408 49.4443 57.7088 61.5199 (67)
 59.8563
 53.1638
 43.2357
 32.7322
 24.4677
 20.6567
 22

 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
 377.0508
 401.1710
 390.7883
 368.6850
 340.7834
 314.5598
 297

 Cooking gains (calculated in Appendix L, equation L15 or L13a), also see Table 5
 54.5314
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 297.0409 292.9208 303 3034 325 4068 353 3084 379.5319 (68) 54.5314 54.5314 54.5314 54.5314 54.5314 (69) 54,5314 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70) Fulls 3.00000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.00000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0 128,8568 126,5360 121,7167 115,1648 110,9111 104,9217 99,8309 106.3536 108.6712 115.4525 123.1098 126.5457 (72) Total internal gains 699.0993 694.2062 669.0761 629.9174 589.4977 553.4737 532.5275 541.6226 564.2508 603.6390 647.4624 680,9329 (73)

	 	 	and a second state of the
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	1.2000	11.5683	0.7200	0_7000	0.7700	4.8486 (74)
East	18.0000	21.5704	0.7200	0 7000	0.7700	135.6105 (76)
South	1.3100	29.0000	0.7200	0-7000	1.0000	17.2323 (82)

 Solar gains
 157.6914
 278.5330
 464.2402
 705.0441
 846.4422
 927.8264
 879.9502
 771.0888
 594.9254
 362.0738
 203.3798
 127.1094
 (83)

 Total gains
 856.7907
 972.7392
 1133.3164
 1334.9615
 1435.9399
 1481.3000
 1412.4777
 1312.7114
 1159.1762
 965.7129
 850.8422
 808.0422
 (84)

7. Mean internal temperature (heating season)

**********					-					-			*****	 	
Temperature	during	heating	periods	in	the	living	area	from	Table	9,	Thl	(C)			

Utilisation fa	actor for ga	ins for liv	ving area, r	nil,m (see 7	Table 9a)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	17.6944	17.6944	17.6944	17.6944	17,6944	17.6944	17.6944	17.6944	17,6944	17.6944	17.6944	17 6944
alpha	2,1796	2.1796	2.1796	2.1796	2.1796	2.1796	2.1796	2.1796	2.1796	2.1796	2,1796	2,1796
util living an	rea											
	0.9386	0.9189	0.8686	0.7752	0.6371	0,4425	0.2803	0.3204	0.5957	0.8162	0.9121	0.9447 (86)
MIT	18.8984	19.0889	19,5559	20,0706	20.5076	20.7729	20.8545	20.8449	20.6464	20,1112	19.4183	18.8535 (87)
Th 2	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355 (88)
util rest of 1	house											
	0.9279	0.9048	0.8447	0.7330	0.5642	0.3285	0.1326	0.1667	0.4901	0.7701	0.8937	0.9349 (89)
MIT 2	16.9158	17.1870	17.8479	18.5528	19,1138	19.3982	19.4533	19.4504	19.2878	18.6311	17.6651	16.8522 (90)
Living area fi	raction								£LA =	Living area	/ (4) =	0.3295 (91)
MIT	17.5690	17.8136	18.4106	19.0528	19.5730	19.8511	19,9149	19.9098	19.7354	19.1188	18.2428	17.5116 (92)
Temperature ad	djustment.											0.0000
adjusted MIT	17.5690	17.8136	18.4106	19.0528	19.5730	19.8511	19.9149	19.9098	19.7354	19.1188	18.2428	17.5116 (93)

8. Space heating requirement

o. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9057	0.8800	0.8179	0.7117	0.5605	0.3479	0.1642	0,1994	0.4988	0.7485	0.8688	0.9139	(94)
Useful gains	776.0027	856,0041	926.8896	950,1391	804.7955	515.3175	231.9745	261,7031	578.1964	722.8435	739.1698	738.4475	(95)
Ext temp.	5.4000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.6000	12.1000	8,4000	5.4000	(96)
Heat loss ra	te W												
	2029.3826	1986.7896	1752.8201	1443.0039	1012.7787	558.8591	235.9654	268.4629	689.6474	1170.4946	1641.4437	2019.8014	(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	g kWh												
	932.5146	759.8879	614.4923	354.8626	154.7395	0.0000	0.0000	0.0000	0.0000	333.0524	649.6372	953.3273	(98)
Space heating	9											4752.5139	(98)
RHI space he	ating deman	d										4753	(98)

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

1. Overall dwelling dimensions

	Area	Sto	rey height			Volume		
	(m2)		(m)			(m3)		
	41.1800 (1b) x	2.7000	(2b)	=	111.1860	(1b)	- (3b)
	40.3200 (1c	x (2.7000	(2c)		108.8640	(1c)	- (3c)
	24,7300 (1d	x	1.9800	(2d)		48.9654	(1d)	- (3d)
106.2300							(4)	
	(3a) +	(3b) + (3)	c) + (3d) + (3e)	(3n) =	269.0154	(5)	
	106.2300	Area (m2) 41.1800 (1b 40.3200 (1c) 24.7300 (1d) 106.2300 (3a)+	Area Sto (m2) 41.1800 (1b) x 40.3200 (1c) x 24.7300 (1d) x 106.2300 (3a)+(3b)+(3	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 40.3200 (1c) x 2.7000 24.7300 (1d) x 1.9800 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 (2b) 40.3200 (1c) x 2.7000 (2c) 24.7300 (1d) x 1.9800 (2d) 106.2300 (3a) + (3b) + (3c) + (3d) + (3e) (3n	Area Storey height (m2) (m) 41.1800 (b) x 2.7000 (2b) = 40.3200 (1c) x 2.7000 (2c) = 24.7300 (1d) x 1.9800 (2d) = 106.2300 (3a) + (3c) + (3c) + (3c)(3n) =	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

2. Ventilation rate

					main	se	condary		other	tota	1 m3	3 per hour	
					heating		heating					1000	
Number of chin	meys				Q	+	0		D.	ē	0 * 40 =	0.0000	(6a)
Number of open	n flues				0	+	0	+	Q		0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans									0 * 10 =	0.0000	(7a)
Number of pas:	sive vents										0 * 10 =	0.0000	(7b)
Number of flue	eless gas fi	ires									0 * 40 =	0.0000	(7c)
											Air changes	per hour	
Infiltration of Pressure test	due to chim	neys, flues	and fans	= (6a)+(6b))+(7a)+(7b)-	+(7c) =				0.0000	/ (5) =	0.0000 Yes	(8)
Measured/desig	gn q50											0.0000	(20)
Number of side	es sheltered	E										2 2	(19)
Shelter facto	r								(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration :	rate adjuste	ed to includ	le shelter f	actor					1	(21) = (18) :	x (20) =	0.2125	(21)
				1.1		Jan 9		1.1	1			-	
and the second second	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	OCE	NOV	Dec	1001
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	1,1/50	(22a)
Adj infilt rat	te								1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	A. 335.7	1. 1492.61		
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical ext	tract ventil	lation - dec	entralised										
If mechanical	ventilation	n.:										0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0,5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0 5000	(25)

Element	Gross	Openings	NetArea	U-value	AxU	K-value	AxK
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722		(27)
Opening Type 2			2.2100	3.0000	6.6300		(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699		(27a)
Heat Loss Floor 1			41.1800	0.1800	7.4124		(28a)
Wall 1	124.7400	21.4100	103.3300	0.2400	24.7992		(29a)
Wall 2	11.3400		11.3400	0.3200	3.6288		(29a)
Wall 3	20.8000		20,8000	0.1500	3.1200		(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1500	4.8480		(30)
External Roof 2	5.4000		5.4000	0.1300	0.7020		(30)
External Roof 3	15.5900		15,5900	0.1600	2.4944		(30)
Total net area of external elements A	um(A, m2)		252.6800				(31)
Fabric heat loss, $W/K = Sum (A \times U)$			(26)	. (30) + (32) =	84,4769		(33)
Thermal mass parameter (TMP = Cm / TF	A) in kJ/m2K						100.0000 (35)
Thermal bridges (Default value 0.150	 total exposed area. 	1					37.9020 (36)
Total fabric heat loss						(33) + (36) =	122.3789 (37)

 Ventilation
 heat
 loss
 calculated
 monthly
 (38) m
 =
 0.33 x
 (25) m x
 (5)

 Jan
 Feb
 Mar
 Apr
 May

 (38) m
 46.2463
 45.7747
 45.3030
 44.3875
 44.3875
 Jul 44.3875 Jun 44.3875 Aug 44.3875 Sep 44.3875 Oct 44.3875 Nov 44.3875 Dec 44,3875 (38) Heat transfer coeff 166.7664 (39) 167.1132 (39) May 1.5699 Jun 1.5699 Jul Aug 1.5699 Sep 1.5699 Jan Feb Mar Apr 1.5699 Oct Nov Dec HLP HLP (average) 1.5699 1.5699 1.5699 1.5699 (40) 1.5731 (40) 1.5874 1.5829 1.5785

Days in month 31 28 31 30 31 30 31 31 30 31 30 31 41)

4. Water heat	ing energy	requirement	s (kWh/year)	بمنتميتنيه								
Assumed occup	ancy											2.7902	(42)
Average daily	hot water	use (litres	(day)									100.4673	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot wat	er use												
	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98-4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147,9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy conter	t (annual)									Total = S	um(45)m =	1580.7412	(45)
Distribution	loss (46) m	n = 0.15 x (45)m										
	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23-8077	(46)
Water storage	loss:												
Store volume												125.0000	(47)
a) If manufa	cturer decl	ared loss f	actor is kn	own (kWh/d	ay):							1.7000	(48)
Temperature	factor from	n Table 2b			100							0.5400	(49)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Enter (49) or	(54) in (5	55)										0.9180) (55)
Total storage	loss												
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder c	ontains dec	dicated sola	r storage										
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23,2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat re	quired for	water heati	ng calculat	ed for each	month								
	215.6094	190.0536	199.6328	179.0056	175.4545	156.8251	150.6614	165.2566	164.9442	185.6162	196.2097	210.4382	(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 inpu	t (sum of m	onths) = Su	um (63) m =	0.0000	(63)
Output from w	/h												
	215.6094	190.0536	199.6328	179.0056	175.4545	156.8251	150.6614	165.2566	164.9442	185.6162	196.2097	210,4382	(64)
								Total pe	r year (kWh	/year) = Su	m(64)m =	2189,7072	(64)
Heat gains fr	om water he	eating, kWh/	month										
	95.8694	85.0322	90.5572	82,9187	82.5179	75.5437	74.2742	79.1271	78.2432	85.8967	88.6390	94.1500	(65)

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

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 Metabolic gains (Table 5), Watts Jul Aug Sep Oct 167.4120 167.4120 167.4120 167.4120 Oct Dec 167.4120 167.4120 (66) 22.3203 29,0127 38.9408 49.4443 57.7088 61.5199 (67) 297.0409 292.9208 303.3034 325.4068 353.3084 379.5319 (68) Pumps, fans 3.00000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0 54.5314 54.5314 (69) 54.5314 54.5314 54,5314 54.5314 3.0000 (70) 128.8568 126.5360 121.7167 115.1648 110.9111 104.9217 99.8309 106.3536 108.6712 115.4525 123.1098 126.5457 (72) Total internal gains 699.0993 694.2062 669.0761 629.9174 589.4977 553.4737 532.5275 541.6226 564.2508 603.6390 647,4624 680,9329 (73)

6. Solar gains

[Jan]			A	rea m2	Solar flux Table 6a W/m2	Specif or 7	g fic data Table 6b	Specific or Tabl	FF data e 6c	Acce facto Table 6	ass d	Gains W	¥.
North	1001010001		1.2	000	10.6334		0.7200	(,7000	0.77	00	4.4567	(74)
East			18.0	000	19.6403		0.7200	(.7000	0.77	00	123.4763	\$ (76)
South			1.3	100	26.0000		0.7200	C	.7000	1.00	00	15.4496	(82)
Solar gains	143,3826	282.1505	469.3089	692.5343	856,4069	880.2044	836.5364	713.3408	548.3836	335.9712	179.0675	117.7348	(83)
Total gains	842.4819	976.3567	1138.3850	1322.4517	1445.9046	1433.6780	1369.0639	1254.9634	1112.6344	939.6102	826.5299	798 6677	(84)

7. Mean inter	nal temperat	ure (heatin	ig season)									
Temperature d	uring heatin	g periods i	n the livin	g area from	Table 9, T	ch1 (C)						21.0000 (85)
Utilisation f	actor for ga	ins for liv	ing area, n	il,m (see 1	able 9a)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	17.4994	17.5484	17,5978	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17,6944	17 6944
alpha	2.1666	2.1699	2.1732	2.1796	2.1796	2.1796	2.1796	2.1796	2,1796	2.1796	2.1796	2.1796
util living a	rea											
	0.9475	0.9272	0.8877	0,8144	0.7092	0.5802	0.4619	0.5085	0.6969	0.8595	0.9294	0.9528 (86)
MIT	18.6667	18.9006	19,3167	19.8415	20.2989	20.6183	20.7659	20.7356	20.4644	19.8571	19.1709	18.6304 (87)
Th 2	19.6226	19.6259	19.6292	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355 (88)
util rest of	house											
	0.9388	0.9152	0.8686	0.7816	0.6547	0.4932	0.3419	0.3882	0.6196	0.8270	0.9156	0.9449 (89)
MIT 2	16.5742	16,9103	17.5039	18.2390	18.8503	19.2432	19.3953	19.3722	19.0804	18.2823	17.3105	16.5288 (90)
Living area f	raction								fLA =	Living area	/ (4) =	0.3295 (91)
MIT	17.2636	17.5661	18.1011	18.7670	19.3276	19.6962	19.8469	19 8214	19.5364	18.8012	17.9234	17.2213 (92)
Temperature a	djustment											0.0000
adjusted MIT	17.2636	17.5661	18.1011	18.7670	19.3276	19.6962	19.8469	19.8214	19.5364	18.8012	17.9234	17.2213 (93)

8. Space heating requirement

Apr 0.7566 1000.5472 May 0.6406 926.2639 Aug 0.4062 509.7891 Sep 0.6130 682.0990 Feb Jun Jul Oct Jan Mar Nov Dec Utilisation 0.9181 Useful gains 773.5018 0.8911 870.0579 0.8416 958.0731 0.4975 0.3621 0.8018 0,8922 0.9254 (94) 739.1227 (95) Ext temp. 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) 4.9846 2171.5077 (97) 1.0000 1.000 7.6809 1804.9846 1.0000 2 2185.9926 2129.8440 Month fracti 1.0000 1945.3007 1645.4807 1272.0242 849.8820 541.4733 570.5772 906.6118 1367.6809 0.0000 1.0000 (97a) 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 Space heating kWh 1050.8932 846.5763 734.4973 464.3521 257.2457 457,0096 768.6290 1065.6944 (98) 5644.8976 (98) (98) / (4) = 53.1385 (99) 0.0000 0.0000 0.0000 0.0000 Space heating Space heating per m2

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)

 1.0000 (202)

 Efficiency of main space heating system 1 (in %)

CALCULATION DETAILS for s CALCULATION OF ENERGY	survey refe RATINGS	rence no ' 09 Jan	ASHP' 2014								Page: 20 of 32
Efficiency of secondary/supplementa Space heating requirement	ary heating	system, %	1							0.0000 3223.8136	(208) (211)
Jan Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement 1050.8932 846.5763	734.4973	464.3521	257.2457	0.0000	0.0000	0.0000	0.0000	457.0096	768.6290	1065.6944	(98)
Space heating efficiency (main heat	ing system	1)	175 1000	0.0000	0.0000	0 0000	0 0000	175 1000	175 1000	175 1000	(210)
Space heating fuel (main heating sy	/stem)	173.1000	175.1000	0.0000	0.0000	0.0000	0.0000	200,2000	170.000		(210)
600.1674 483.4816 Water heating requirement	419.4731	265.1925	146,9136	0,0000	0.0000	0.0000	0.0000	260.9992	438.9657	608.6205	(211)
0.0000 0.0000	0.0000	0.000	0.0000	0.0000	0_0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating requirement											
215.6094 190.0536 Efficiency of water heater	199.6328	179.0056	175,4545	156.8251	150.6614	165.2566	164.9442	185.6162	196_2097	210.4382 175.1000	(64) (216)
(217)m 175.1000 175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.100	175,1000	(217)
123.1350 108.5400	114.0107	102.2305	100.2024	89.5632	86 0430	94.3784	94.2000	106.0058	112.0558	120.1817	(219)
water heating fuel used Annual totals kwh/year Space heating fuel - main system Space heating fuel - secondary										3223.8136 0.0000	(211) (211) (215)
Electricity for pumps and fans: (MEVDecentralised, Database: tot mechanical ventilation fans (SFP central heating pump Total electricity for the above, kk Electricity for the above, kk Electricity for lighting (calculate Total delivered energy for all uses	tal watage = = 0.3 Wh/year ed in Append s	12.8150, t 464) lix L)	otal flow :	= 37.0000, S	SFP ≈ 0.3464	Э́				113.6721 30.0000 143.6721 422.8324 5040.8647	(230a) (230c) (231) (232) (238)
10a. Fuel costs - using Table 12 pr	rices										
Space heating - main system 1 Space heating - secondary Water heating (other fuel) Mechanical ventilation fans Pumps and fans for heating Energy for lighting Additional standing charges Total energy cost						Fuel kWh/year 3223.8136 0.0000 1250.5467 113.6721 30.0000 422.8324		p/kWh 13.1900 0.0000 13.1900 13.1900 13.1900 13.1900		fuel cost £/year 425.2210 0.0000 164.9471 14.9933 3.9570 55.7716 0.0000 664.8901	(240) (242) (247) (249) (249) (250) (251) (255)
lla. SAP rating - Individual heatin	1g systems										
Energy cost deflator (Table 12):	******		********	•••••	*********	*********				0.4200	(256)
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band						1(255) x (256	;)] / [(4) +	45.0] =	1.8456 74_2406 74 C	(257) (258)
12a. Carbon dioxide emissions - Ind	lividual hea	ting system	s including	g micro-CHP							
Space heating - main system 1 Space heating - secondary Water heating (other fuel) Space and water heating						Energy kWh/year 3223.8136 0.0000 1250.5467	Emissi }	on factor g CO2/kWh 0.5190 0.0000 0.5190	3	Emissions (g CO2/year 1673.1593 0.0000 649.0337 2322.1930	(261) (263) (264) (265)
Pumps and fans Energy for lighting Total kg/year CO2 emissions per m2 EI value EI rating EI band						143.6721 422.8324		0.5190		74.5658 219.4500 2616.2088 24.6300 76.8186 77 C	(267) (268) (272) (273) (274)
Calculation of stars for heating an	1d DHW										
Main heating energy efficiency Main heating environmental impact Water heating energy efficiency Water heating environmental impact			0100100011	Q	13,19 × (1 .519 * (1 +	+ 0.29 × 0. 0.29 × 0.2 13 0.5	25) / 1.751 5) / 1.7510 .19 / 1.7510 19 / 1.7510	0 = 8.079, 0 = 0.3179, 0 = 7.533, 0 = 0.2964,	stars = 2 stars = 4 stars = 2 stars = 4		

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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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		Store	y height			Volume		
	(m2)			(m)			(m3)		
	41.1800	(1b)	x	2.7000	(2b)	×	111.1860	(1b)	- (3b)
	40.3200	(1c)	x	2.7000	(2c)	=	108.8640	(1c)	- (3c)
	24.7300	(1d)	x	1.9800	(2d)	-	48.9654	(1d)	- (3d)
106.2300								(4)	
	(3a	a) + (3)	o)+(3c)	+(3d)+(3e)	(3n	=	269.0154	(5)	
	106.2300	Area (m2) 41.1800 40.3200 24.7300 106.2300 (3;	Area (m2) 41.1800 (1b) 40.3200 (1c) 24.7300 (1d) 106.2300 (3a)+(31	Area Store (m2) 41.1800 (1b) x 40.3200 (1c) x 24.7300 (1d) x 106.2300 (3a)+(3b)+(3c)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 40.3200 (1c) x 2.7000 24.7300 (1d) x 1.9800 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)	Area Storey height (m2) (m) 41.1800 (1b) x 2.7000 (2b) 40.3200 (1c) x 2.7000 (2c) 24.7300 (1d) x 1.9800 (2d) 106.2300 (3a)+(3b)+(3c)+(3d)+(3e)(3n)	$\begin{array}{ccccc} & \mbox{Area} & \mbox{Storey height} & & & & & & & & & & & & & & & & & & &$	$\begin{array}{ccccccc} & & & & & & & & & & & & & & & &$	$\begin{array}{cccccccc} & Area & Storey height & Volume \\ (m2) & (m) & (m3) \\ & 41.1800 & (1b) & x & 2.7000 & (2b) & = & 111.1860 & (1b) \\ & 40.3200 & (1c) & x & 2.7000 & (2c) & = & 108.8640 & (1c) \\ & 24.7300 & (1d) & x & 1.9800 & (2d) & = & 48.9654 & (1d) \\ & 106.2300 & & (4) \\ & & (3a) + (3b) + (3c) + (3d) + (3e) & \dots & (3n) & = & 269.0154 & (5) \end{array}$

2. Ventilation rate

					main	se	condary		other	tota	i m	3 per hour	
					heating		heating				2		10.5
Number of chim	neys				0	+	0	+	0	<i>(</i> =	0 * 40 =	0.0000	(6a)
Number of open	flues				0		0	+	0	5	0 * 20 =	0.0000	(6b)
Number of inte	rmittent fa	ans									0 * 10 =	0.0000	(7a)
Number of pass	ive vents										0 * 10 =	0.0000	(7b)
Number of flue	less gas fi	ires									0 * 40 =	0.0000	(7c)
											Air change	s per hour	
Infiltration d Pressure test	ue to chimm	neys, flues	and fans	= (6a) + (6b)) + (7a) + (7b) +	+(7c) =				0.000	/ (5) =	0.0000 Yes	(8)
Measured/desig	n q50											5.0000	
Infiltration r	ate											0.2500	(18)
Number of side	s sheltered	1										2	(19)
Shelter factor									(20) = 1	- [0.075 x	(19)) =	0.8500	(20)
Infiltration r	ate adjuste	ed to includ	le shelter f	actor						(21) = (18)	x (20) =	0.2125	(21)
	Jan	Feb	Mar	Anr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4 3000	4 2000	4 1000	3,9000	3,9000	3.4000	3,6000	3,4000	3,4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0500	1.0250	0.9750	0.9750	0.8500	0.9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adi infilt rat	0			5.2045		319813	0.12.02.0		Constant a	0.15.15.0			1.00
may incluse inc	0 2294	0 2221	0 2179	0 2072	0 2072	0 1806	0 1913	0 1806	0 1806	0 1966	0 1913	0 2125	(22h)
Maghanigal out	vizzon	lation day	untraliged	0.2012	0.20/2	0.1000	0.4745	0.1000	0.2000	0.2500			10001
If mechanical	ventilation		encrarised									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)

Element	Gross	Openings	NetArea	U-value	AxU	K-value	AxK
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K
Opening Type 1 ($Uw = 1.60$)			19.2000	1.5038	28.8722		(27)
Opening Type 2			2.2100	3.0000	6,6300		(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699		(278
Heat Loss Floor 1			41.1800	0.1800	7,4124		(28a
Wall 1	124.7400	21.4100	103.3300	0.2400	24.7992		(29a
Wall 2	11.3400		11.3400	0.3200	3,6288		(29a
Wall 3	20.8000		20.8000	0.1500	3.1200		(298
External Roof 1	33.6300	1.3100	32.3200	0.1500	4.8480		(30)
External Roof 2	5.4000		5.4000	0.1300	0.7020		(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944		(30)
Total net area of external elements A	um (A, m2)		252.6800				(31)
Fabric heat loss, $W/K = Sum (A \times U)$			(26)	. (30) + (32) =	84.4769		(33)
Thermal mass parameter (TMP = Cm / TF	A) in kJ/m2K						100.0000 (35)
Thermal bridges (Default value 0.150	* total exposed area						37.9020 (36)
Total fabric heat loss						(33) + (36) =	122.3789 (37)

 Ventilation heat loss calculated montnly (38) m = 0.33 x (25) m = 7 May
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31 30 31 30 31 31 30 31 30 31 (41) 31 28

				and the state of the	والمستحدث والمستحد								
4. Water heati	ng energy	requirement	s (kWh/year	6									
Assumed occupa	ncy											2.7902	(42)
Average daily	hot water	use (litres	/day)									100.4673	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct.	Nov	Dec	
Daily hot wate	r use												
	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106 4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106,7731	98.9410	113.5362	114.8922	133.8958	146.1577	158,7178	(45)
Energy content	(annual)									Total = S	um (45) m =	1580.7412	(45)
Distribution 1	oss (46)m	= 0.15 x (45)m										
	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14 8411	17.0304	17,2338	20.0844	21.9237	23,8077	(46)
Water storage	loss:												
Store volume												125.0000	(47)
a) If manufac	turer decl	ared loss f	actor is know	own (kwh/da	ay):							1.7000	(48)
Temperature f	actor from	Table 2b										0.5400	(49)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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Enter (49) or	r (54) in (5	5)										0.9180	(55)
Total storage	e loss												
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder of	contains dec	licated sola	r storage										
	28,4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22,5120	23.2624	(59)
Total heat re	equired for	water heati	ng calculat	ed for each	month								
	215.6094	190.0536	199.6328	179.0056	175.4545	156.8251	150.6614	165.2566	164.9442	185 6162	196.2097	210.4382	(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 inpu	t (sum of r	nonths) = Su	um(63)m =	0.0000	(63)
Output from w	w/h												
	215.6094	190 0536	199.6328	179.0056	175.4545	156.8251	150.6614	165.2566	164 .9442	185,6162	196.2097	210.4382	(64)
								Total pe	r year (kWh	n/year) = Su	um(64)m =	2189.7072	(64)
Heat gains fo	com water he	ating, kWh/	month										
	95.8694	85.0322	90.5572	82.9187	82.5179	75.5437	74.2742	79.1271	78 2432	85.8967	88,6390	94.1500	(65)
	وتبتعتنيني		فليت فالمحادث	فتجبره تجبيفتها	******			*********					

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

Metabolic gains (Table 5), Watts Jan Feb (66)m 167.4120 167.4120
 Metabolic gains (Table 5), Watts
 Jan
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 May
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 Jul
 Aug
 Sep
 Oct
 Nov
 Dec

 (66)m
 167.4120
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 Nov Dec 167.4120 167.4120 (66) 397.0508 401.1710 390.7883 368.6850 340.7834 314.5598 3 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 54.5314 54.5314 54.5314 54.5314 54.5314 54 5314 (69) 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70) Losses e.g. evaporation (negative values) (Table 5) -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 (71) Losses e.g. evaporation (neget: -111.6080 -111.6080 -111.6080 -111.6080 Water heating gains (Table 5) 128.8568 126.5360 121.7167 115.1648 110.9111 104.9217 99,8309 106,3536 108,6712 115,4525 123,1098 126,5457 (72) 532.5275 541.6226 564.2508 603.6390 647.4624 680.9329 (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	1.2000	11.5683	0.7200	0.7000	0.7700	4.8486 (7
East	18,0000	21.5704	0.7200	0.7000	0_7700	135 6105 (7)
South	1.3100	29.0000	0.7200	0.7000	1.0000	17.2323 (8)

Solar gains 157.6914 278.5330 464.2402 705.0441 846.4422 927.8264 879.9502 771.0888 594.9254 362.0738 203.3798 127.1094 (83) Total gains 856.7907 972.7392 1133.3164 1334.9615 1435.9399 1481.3000 1412.4777 1312.7114 1159.1762 965.7129 850.8422 808.0422 (84)

7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9. Thi (C).

remperature during nearing periods in the riving area from table 9, ini (c)											21,0000 (85)	
Utilisation fa	actor for ga	ins for liv	ing area, n	il,m (see 1	Table 9a)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944	17.6944
alpha	2.1796	2.1796	2.1796	2.1796	2.1796	2,1796	2,1796	2.1796	2,1796	2.1796	2.1796	2,1796
util living an	rea											
	0.9386	0.9189	0.8686	0_7752	0.6371	0.4425	0.2803	0.3204	0.5957	0.8162	0.9121	0.9447 (86)
MIT	18.8984	19.0889	19.5559	20.0706	20.5076	20.7729	20.8545	20.8449	20.6464	20.1112	19.4183	18.8535 (87)
Th 2	19.6355	19.6355	19.6355	19.6355	19,6355	19.6355	19.6355	19.6355	19.6355	19.6355	19.6355	19,6355 (88)
util rest of h	nouse											
	0.9279	0.9048	0.8447	0.7330	0.5642	0.3285	0.1326	0.1667	0.4901	0.7701	0.8937	0.9349 (89)
MIT 2	16.9158	17.1870	17.8479	18.5528	19.1138	19.3982	19.4533	19.4504	19 2878	18.6311	17.6651	16.8522 (90)
Living area fr	action								fLA =	Living area	/ (4) =	0.3295 (91)
MIT	17.5690	17.8136	18,4106	19.0528	19.5730	19.8511	19.9149	19.9098	19,7354	19,1188	18.2428	17.5116 (92)
Temperature ad	ijustment											0.0000
adjusted MIT	17.5690	17.8136	18.4106	19,0528	19.5730	19,8511	19.9149	19.9098	19.7354	19.1188	18.2428	17.5116 (93)

8. Space heating requirement

Aug 0.1994 261.7031 Apr 0.7117 950.1391 May 0.5605 804.7955 Jan Feb Mar Jun Jul Sep OCT. Nov Dec 0.8179 926.8896 7.9000 0.9139 (94) 738.4475 (95) 5.4000 (96) Utilisation 0.9057 Useful gains 776.0027 0.8800 856.0041 0.3479 0.1642 231.9745 0.4988 578.1964 0.7485 0.8688 2029.3826 1986.7896 1752.8201 1443.0039 Month fracti 1.0000 1.0000 1.0000 3.000 Space heating kWh 13.5000 8.4000 Ext temp. 5.4000 5,9000 10,4000 16.5000 18.5000 18.3000 15.6000 12.1000 235.9654 268.4629 689.6474 2019.8014 (97) 1012.7787 558.8591 1170.4946 1641.4437 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 0.0000 1.0000 (97a) 1.0000 932.5146 759.8879 614.4923 354.8626 154.7395 0.0000 0.0000 0 0000 0.0000 333.0524 649.6372 953 3273 (98) 4752.5139 (98) 44.7380 (99) Space heating (98) / (4) = Space heating per m2

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 %)	175_1000	(206)

CALCULATION DETAILS for s CALCULATION OF EPC COS	survey refe TS, EMIS	erence no ' SIONS AN	ASHP' D PRIMAI	RY ENERG	GY 09 J	an 2014					Page: 23 of 32
Efficiency of secondary/supplementa	ary heating	system. %	1							0.0000	(208)
space neating requirement				Ture	2 3	B	C	Cat	None	£/19.1/12	1277)
Jan Feb Space heating requirement	Mar	Apr	May	Jun	Jul	Aug	sep	00E	VOV	Dec	(58)
Space heating efficiency (main heat	ing system	1)	154,7395	0.0000	0.0000	0.0000	0.0000	333.0524	175 1000	175 1000	(33.0)
Space heating fuel (main heating sy	175.1000 (stem)	1/5,1000	1/5,1000	0,0000	0.0000	0.0000	0,0000	100 2020	175,1000	EAA 4472	(210)
Water heating requirement	350.9379	202.6628	88.3721	0.0000	0.0000	0.0000	0.0000	190.2070	371.0093	544.4475	(211)
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	100 (200	178 0056	175 4545	156 0251	160 6614	168 2566	164 9442	195 6162	196 2097	210 4382	(64)
Efficiency of water heater	199.6328	179.0056	1/5.4545	136.8251	150.6614	105.2500	104.3442	103.0102	125 1000	175.1000	(216)
Fuel for water heating, kWh/month	1/5.1000	1/5.1000	1/5.1000	175,1000	1/5.1000	1/5.1000	1/5.1000	1/5/1000	112 0558	120 1017	(210)
Water heating fuel used	114 0107	102 2305	100.2024	89.5632	86.0430	34.3/04	94.2000	106.0038	112.0350	1250.5467	(219)
Space heating fuel - main system Space heating fuel - secondary										2714.1712 0.0000	(211) (215)
Electricity for pumps and fans: (MEVDecentralised, Database: tot mechanical ventilation fans (SFP central heating pump Total electricity for the above, kk Electricity for lighting (calculate Total delivered energy for all uses	al watage = = 0,: b/year d in Append	= 12.8150, t 3464) dix L)	cotal flow	= 37.0000, 5	SFP = 0.3464	ì				113.6721 (30.0000 (143.6721 422.8324 4531.2224	(230a) (230c) (231) (232) (238)
10a, Fuel costs - using BEDF prices	(387)										
Space heating - main system 1 Space heating - secondary Water heating (other fuel) Mechanical ventilation fans Pumps and fans for heating						Puel kWh/year 2714.1712 0.0000 1250.5467 113.6721 30.0000	1	Fuel price p/kWh 15.3200 0.0000 15.3200 15.3200 15.3200		Fuel cost £/year 415.8110 0.0000 191.5837 17.4146 4.5960	(240) (242) (247) (249) (249)
Energy for lighting Additional standing charges Total energy cost						422.8324		15.3200		64.7779 0.0000 694.1833	(250) (251) (255)
12a. Carbon dioxide emissions - Ind	lividual hea	iting system	s including	g micro-CHP							
						Energy kWh/wear	Emissi	on factor	ko	Emissions	
Space heating - main system 1						2714.1712		0.5190		1408.6549	(261)
Water heating (other fuel)						1250.5467		0.5190		649.0337 2057 6886	(264)
Pumps and fans Energy for lighting Total kg/year						143.6721 422.8324		0.5190 0.5190		74.5658 219.4500 2351.7044	(267) (268) (272)
13a. Primary energy - Individual he	ating syste	ems includir	ig micro-CHI	р.							
	0101010					Energy F	rimary ener	gy factor	Prima	ry energy	
Space heating - main system 1 Space heating - secondary						2714.1712 0.0000		3.0700		8332.5057 0.0000	(261) (263)
Space and water heating						143 6721		3.0700		12171.6839	(265)
Pumps and rans Energy for lighting Primary energy kWh/year Primary energy kWh/m2/year						422.8324		3.0700		1298.0954 13910.8527 130.9503	(268) (272) (273)
SAP 2012 EPC IMPROVEMENTS											
		******	*********								
Current energy efficiency rating: Current environmental impact rating	F:			C 74 C 77							
(For testing purposes): A				Not	considered						
B C				Not	considered considered						
D E Low energy lighting				Not Alread	considered by installed						
F G				Not	considered considered						
H I				Not	considered considered						
J K				Not	considered considered						
M N Solar water heating				Not	considered mended						
O P R				Not Not	considered considered considered						

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S		Not	considered
T		Not	considered
U Solar photovoltaic panels		Recom	mended
A2		Not	considered
A3		Not	considered
T2		Not	considered
W		Not	considered
x		Not	considered
Y		Not	considered
J2		Not	considered
Q2		Not	considered
21		Not	considered
Z2		Not	considered
Z3		Not	considered
24		Not	considered
Z5		Not	considered
V2 Wind turbine		Not a	pplicable
L2		Not	considered
Q3		Not	considered
03		Not	considered
Recommended measures: S	AP change Cost	change CO2 cha	nge
N Solar water heating	+ 2.5 -£	75 -254 k	g (10.8×)
U Solar photovoltaic panels	+ 8.8 -£ 2	.74 -928 k	g (44.2%)
		Levin, a	

	Typical annual	l savings	efficiency	impact
Recommended measures				
Solar water heating	£75	2.39 kg/m ²	C 77 C	79
Solar photovoltaic panels	£274	8.73 kg/m ²	B 86 B	87
Total Saving	s £349	11.13 kg/m ²		

Potential energy efficiency rating: Potential environmental impact rating:

Fuel prices for cost data on this page from database revision number 387 TEST (20 Jan 2016) Recommendation texts revision number 4.9c (22 Feb 2014)

B 86

B 87

Typical heating and lighting cost	s of this home (p Current	er year, Thames Potential	Saving	
Electricity	£694	£619	£75	
Space heating	£438	1.438	-£.0	
Water heating	£192	£116	£75	
Lighting	£65	£65	£0	
Generated (PV)	-£0	-£274	£274	
Total cost of fuels	£694	£345	£349	
Total cost of uses	£695	£345	£349	
Delivered energy	43 kWh/m ²	21 kWh/m ²	21 kWh/m ²	
Carbon dioxide emissions	2.4 tonnes	1.2 tonnes	1.2 tonnes	
CO2 emissions per m ²	22 kg/m ²	11 kg/m ²	11 kg/m ²	
Primary energy	131 kWh/m ²	65 kWh/m ²	66 kWh/m ²	

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CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

		Area	Store	ey height			Volume		
		(m2)		(m)			(m3)		
Ground floor		41,1800 (1b)	x	2.7000	(2b)	-	111.1860	(1b)	- (3b)
First floor		40 3200 (1c)	x	2.7000	(2c)	=	108.8640	(1c)	- (3c)
Second floor		24,7300 (1d)	x	1.9800	(2d)	-	48.9654	(1d)	- (3d)
Total floor area TFA = $(1a) + (1b) + (1c) + (1d) + (1e) (1n)$	106.2300							(4)	
Dwelling volume		(3a)+(3b) + (3c)	+ (3d) + (3e)	(3n)	=	269.0154	(5)	

2. Ventilation rate

					main	se	condary	3	other	tota	1. m3	per hour	
					heating		heating						
Number of chin	meys				0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open	flues				0	+	0	+	0		0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans									0 * 10 =	0.0000	(7a)
Number of pass	sive vents										0 * 10 =	0.0000	(7b)
Number of flue	eless gas fi	ires									0 * 40 =	0.0000	(7c)
											Air changes	per hour	
Infiltration of Pressure test	lue to chim	neys, flues	and fans	= (6a)+(6b))+(7a)+(7b)+	+(7c) =				0.0000	/ (5) =	0.0000 Yes	(8)
Theasured/ desig	ate .											0 2500	1181
Number of side	es sheltered	đ										2	(19)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration :	ate adjuste	ed to includ	le shelter f	actor					(21) = (18) :	x (20) =	0.2125	(21)
	Tan	Feb	Mar	Anr	Max	Thirt	701	Aug	Sen	Oct	Nov	Dec	
Wind eneed	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	(222)
Adi infilt rat	1.2/30	1.2500	1,2230	1,1000	1.0150	0,5500	0.0000	0.5250	1.0000	210100		1,1/50	(1220)
Muj milite tai	0 2709	0 2656	0 2602	0 2338	0 2284	0 2019	0 2019	0 1966	0 2125	0 2284	0 2391	0 2497	(22h)
Machanical out	viaros	lation da	cotralized	9.2230	0.2204	0.2015	0.2013	0.1200	0.2323	0.2201	0.2372	0.2351	(seal)
If mechanical	ventilation	ación - dec	encratiseu									0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	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	Openings	Ne	tArea	U-value	Axt	ĸ	-value	AxK	
				m2	m2		m2	W/m2K	W/K	k	J/m2K	kJ/K	
Opening Typ	e 1 (Uw = 1.60	(0				15	.2000	1.5038	28.8722				(27)
Opening Typ	e 2					2	.2100	3.0000	6.6300	R. H.			(26)
Opening Typ	e 3 (Uw = 1.60	0)					.3100	1.5038	1.9699	6 C 1			(27a)
Heat Loss F	loor 1					41	.1800	0.1800	7.4124				(28a)
Wall 1			3	24.7400	21.4100	103	.3300	0.2400	24.7992				(29a)
Wall 2				11.3400		11	.3400	0.3200	3.6288	E			(29a)
Wall 3				20.8000		20	.8000	0.1500	3.1200	6			(29a)
External Ro	of 1			33.6300	1.3100	32	.3200	0.1500	4.8480	Ê L			(30)
External Ro	of 2			5.4000		5	.4000	0.1300	0.7020	P1.			(30)
External Ro	of 3			15.5900		15	.5900	0.1600	2.4944				(30)
Total net a	rea of externa	al elements	Aum(A, m2)			252	.6800						(31)
Fabric heat	10ss, W/K = S	Sum (A x U)					(26)	(30) + (32) =	84.4765	6 II.			(33)
Thermal mas	s parameter (7	CMP = Cm / S	CFA) in kJ/m	n2K								100.0000	(35)
Thermal brin	dges (Default	value 0.150	* total ex	mosed area								37.9020	(36)
Total fabri	c heat loss									(33)	+ (36) =	122,3789	(37)
Ventilation	heat loss cal	lculated mor	thly (38)m	= 0.33 x (:	25)m x (5)								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
de esta	1.2.2.2.2.2.2	100 0000		and the second		and the second			11.5000		44 3955	44 3555	1201

 Oal
 Feb
 Pai
 Pai</th Dec 1.5699 (40) 1.5731 (40) Jan Feb Mar Apr 1.5699 May 1.5699 Jun 1.5699 Jul Aug 1.5699 Sep 1.5699 Oct 1.5699 Nov 1.5699 HLP HLP (average) 1.5874 1.5785 1.5699 1.5829

Days in month 31 28 31 30 31 30 31 31 30 31 30 31 (41)

4. Water heat	ing energy	requirement	s (kWh/year) 									
Assumed occup	oancy											2.7902	(42)
Average daily	hot water	use (litres	/day)									100,4673	(43)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot wat	er use												
	110.5140	106.4953	102.4766	98-4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4756	106.4953	110:5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123,7341	106,7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy conter	it (annual)									Total = S	um(45)m =	1580,7412	(45)
Distribution	loss (46) m	= 0.15 x (45)m										
	24.5834	21.5008	22.1869	19.3430	18.5601	16 0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)
Water storage	loss:												
Store volume												125.0000	(47)
a) If manufa	cturer decl	ared loss f	actor is know	own (kWh/d.	ay):							1.7000	(48)
Temperature	factor from	Table 2b										0.5400	(49)

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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CALCULAT	ION OF	ENERGY	RATINGS F	OR IMPI	ROVED D	WELLING	09 Jan	2014					Page	Î
Enter (49) or ((54) in (55)										0.9180	(55)	4
Total storage 1	28,4580	25.7040	28 4580	27.5400	28,4580	27.5400	28,4580	28.4580	27.5400	28.4580	27.5400	28 4580	(56)	
If cylinder con	1tains dec 28.4580	dicated sol	ar storage 28.4580	27.5400	28,4580	27,5400	28,4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)	
Primary loss Total heat requ	23.2624 lired for	21.0112 water heat	21.8667 ing calculate	15,7584 d for each	10.4681 1000th	9.9053	10.2355	11.1660	17.1091	21.8667	22,5120	23.2624	(59)	
Aperture area o lero-loss colle Collector 2nd o Collector 2nd o Collector perfo Annual solar ra Vyershading fac Solar to-load r Utilisation fac Collector perfo Dedicated solar Effective solar Daily hot water Volume ratio Ve	<pre>115.6094 f solar of cotor eff: loss coel code to the eff: loss coel code to the eff: loss coel code to the eff: code to</pre>	190.0536 collector iciency fficient t loss coef atio per m2 howers actor volume	198.2371 ficient ficient	172.2520	162.6601	144.2184	137.6344	153.1602	159.5413	184,2204	196.2097	210 4382 3.0000 0.7000 1.8003 2.5804 1079 5246 0.8000 1813.6014 1.0000 1.1473 0.5817 0.5817 0.8793 75.0000 75.0000 75.0000 10.4673 0.7465	(62) (H1) (H2) (H3) (H3a) (H3b) (H3b) (H4) (H5) (H6) (H7) (H7) (H7) (H7) (H8) (H9) (H10) (H11) (H14) (H15)	
iolar storage v Solar input Solar input	-25.3275	-42.2643	-71.9810	-96.4687	-119.1789	-117.1719	-115.6234	-101.0207 Solar inpu	-79.1195	-54.0293 months) = S	-30.0421 Sum(63)m =	-873.4221 -21.1948 -873.4221	(H16) (H17) (63) (63)	
utput from w/h 1	90.2819	147.7893	126,2561	75.7833	43.4812	27 0465	22.0110	52.1394 Total pe	80.4218 r vear (kW	130.1911 h/vear) = S	166.1676 Sum(64)m =	189.2434	(64)	
leat gains from	water he 95.8694	eating, kWh, 85.0322	/month 89.4406	77.5158	72.2824	65.4583	63.8526	69.4499	73.9209	84.7801	86.6390	94.1500	(65)	
umps, fans ooking gains (umps, fans osses e.g. eva ater heating g itotal internal 6 . Solar gains Jan]	(calculat 59.8563 is (calculat 57.0508 calculat 54.5314 3.0000 poration 11.6080 gains (Tal 28.8568 gains 99.0993	<pre>ced in Appe:</pre>	Adix L, equat 43.2357 pendix L, equ 390.7883 dix L, equati 54.5314 3.0000 values) (Table -111.6080 120.2159 667.5753 Are Are	ea 22 23 23 24 23 24 23 24 24 25 24 25 24 25 24 25 24 25 24 25 24 25 25 25 25 25 25 25 25 25 25 25 25 25	L9a), also 24.4677 or L13a), also or L13a), a 340.7834 L15a), also 54.5314 3.0000 -111.6080 97.1538 575.7403 Solar flux Table 6a	see Table 9 20.6567 1so see Table 54.5314 3.0000 -111.6080 90.9143 539.4662	5 22.3203 ble 5 297.0409 5 54.5314 3.0000 -111.6080 85.8234 518.5200	29.0127 292.9208 54.5314 3.0000 -111.6080 93.3467 528.6156 Specific	38,9408 303,3034 54,5314 3,0000 -111,6080 102,6680 558,2476 FF data	49,4443 325.4068 54.5314 3.0000 -111.6080 113.9517 602.1382 Acc fact	57,7088 353,3084 54,5314 3,0000 -111,6080 123,1098 647,4624	61.5199 379.5319 54.5314 3.0000 -111.6080 126.5457 680.9329 Gains W	 (67) (68) (69) (70) (71) (72) (73) 	
North			1 20		W/m2	or	Table 6b	or Tabl	e 6c	Table	6d	4 4567	(74)	
Bast South			18.00 1,31	00	19.6403 26.0000		0.7200 0.7200	0 0	.7000	0.7 1.0	700	123.4763 15.4496	(76) (82)	
Solar gains Fotal gains	143.3826 842.4819	282.1505 976.3567	469.3089 1136.8842	692,5343 1314,9477	856.4069 1432.1472	880.2044 1419.6706	836.5364 1355.0564	713.3408 1241.9564	548.3836 1106.6312	335.9712 938.1094	179.0675 826.5299	117.7348 798.6677	(83) (84)	
7. Mean interna	1 tempera	ature (heat)	ing season)											
Temperature dur Utilisation fac	ing heati tor for g	ing periods gains for 1:	in the livin iving area, n	g area fro il,m (see	m Table 9, Table 9a)	Th1 (C)				A-1		21.0000	(85)	
tau alpha	Jan 17.4994 2.1666	reb 17.5484 2.1699	Mar 17.5978 2.1732	Apr 17.6944 2.1796	May 17.6944 2.1796	17.6944 2.1796	17.6944 2.1796	Aug 17.6944 2.1796	17.6944 2,1796	17.6944 2.1796	17.6944 2.1796	17.6944 2.1796		
icii ilving are	0.9475	0.9272	0.8879	0.8158	0.7123	0.5838	0.4655	0.5123	0.6988	0.8599	0.9294	0.9528	(86)	
MIT Fh 2	18.6667 19.6226	18.9006 19.6259	19.3155 19.6292	19.8369 19.6355	20.2931 19.6355	20.6149 19.6355	20.7641 19.6355	20.7334 19.6355	20.4620 19.6355	19.8560 19.6355	19.1709 19.6355	18.6304 19.6355	(87) (88)	
ACTI LESC OF NO	0.9388	0.9152	0.8689	0.7832	0.6580	0.4967	0.3450	0.3915	0.6215	0.8274	0.9156	0.9449	(89)	

 MIT 2
 16.5742
 16.9103
 17.5023
 18.2330
 18.8436
 19.2401
 19.3942
 19.3708
 19.0779
 18.2809
 17.3105
 16.5288
 (90)

 Living area fraction
 fLA
 Living area / (4) =
 0.3295
 (31)

 MIT
 17.2636
 17.5661
 18.0997
 18.7615
 19.3212
 19.6931
 19.8456
 19.8197
 19.5339
 18.7999
 17.9234
 17.2213
 (92)

 Temperature adjustment
 0.0000
 17.3661
 18.0997
 18.7615
 19.3212
 19.6931
 19.8456
 19.8197
 19.5339
 18.7999
 17.9234
 17.2213
 (93)

8. Space heating requirement

A blace weight deriver.

Jan Utilisation 0.9181 Useful gains 773.5018 Ext temp. 4.3000 Heat loss rate W 2017 Month F Feb 0.8911 870.0579 Mar 0.8419 957.1261 6.5000 Apr 0.7581 996.9259 8.9000 May 0.6437 921.9026 Jun 0.5008 710.9656 Jul 0.3651 494.7602 Aug 0.4095 508.5486 Sep 0.6148 680.4036 Oct 0.8022 752.5834 10.6000 Dec 0.9254 (94) 739.1227 (95) 4.2000 (96) Nov 0.8922 737.4443 7.1000 Late W 5.5000 8.9000 11.7000 2185.9926 2129.8440 1945.0561 1644.5592 1270.9570 Month fracti 1.0000 1.0000 1.0000 1.0000 J.0005 Space heating kWh 16,6000 14.6000 16.4000 14.1000 905.2004 1367.4658 1804.9846 2171.5077 (97) 0.0000 1.0000 1.0000 1.0000 (97a) 849.3505 541.2529 570.2947 0.0000 0.0000 0.0000

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Page: 27 of 32

1050.8932 846.5763 735.0200 466.2960 259.6965 0.0000 0.0000 0.0000 0.0000 457.4725 768.6290 1065.6944 (98) Space heating Space heating per m2 (98) / (4) = 53.1891 (99) 8c. Space cooling requirement

Bc. Spa	ace cooling requirement
Not app	plicable

9a. Energy requirements -	Individua	al heating a	systems, inc	cluding micr	O-CHP							
Fraction of space heat fro Fraction of space heat fro Efficiency of main space h Efficiency of secondary/su Space heating requirement	om seconda om main sy meating sy upplementa	ary/suppleme ystem(s) ystem 1 (in ary heating	entary syste \$) system, \$	em (Table 11	.)	********					0.000 1.000 175.100 0.000 3226.886	0 (201) 0 (202) 0 (206) 0 (208) 2 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement		775 0200	166 2960	250 6065	0.0000	0.0000	0.0000	0.0000	457 4725	768 6290	1065 6944	(98)
Space heating efficiency (main heat	ting system	1)	233,6303	0.0000	0.0000	0,0000	0.0000	451.4(25	100.0270	1005.0511	1201
175.1000 1	75.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175,1000	175.1000	(210)
600.1674 4	83.4816	419.7715	266.3027	148.3132	0.0000	0.0000	0,0000	0.0000	261,2636	438.9657	608.6205	(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	(215)
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 190.2819 1	47.7893	126.2561	75.7833	43.4812	27.0465	22.0110	52.1394	80.4218	130.1911	166.1676	189.2434	(64)
Efficiency of water heater					100 1000		105 1000	105 1000	175 1000	175 1000	175,1000) (216)
(217)m 175.1000 Fuel for water heating, kW	175.1000 h/month	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	1/5.1000	175.1000) (217)
108.6704 Water heating fuel used	84.4028	72.1051	43.2800	24.8322	15.4463	12.5705	29.7769	45.9291	74.3524	94.8987	108.0773 714.3419	(219) 9 (219)
Annual totals kWh/year Space heating fuel - main Space heating fuel - secon	system dary										3226.8863 0.0000	2 (211) 0 (215)
(MEVDecentralised, Data mechanical ventilation f central heating pump pump for solar water hea Total electricity for the Electricity for lighting (tans: base: tot ans (SFP ting above, kW calculate	tal watage = = 0.3 Wh/year ed in Append	= 12.8150, t 3464) dix L)	cotal flow =	37.0000, S	FP = 0.3464)				113.6721 30.0000 50.0000 193.6721 422.8324	(230a) (230c) (230g) 1 (231) 4 (232)
Energy saving/generation t PV Unit 0 (0.80 * 2.50 * 1	echnologi 080 * 0.8	ies (Appendi 30) =	ices M ,N ar	ad Q)					-1727.2394		-1727,2394	4 (233)
Total delivered energy for	all uses	5									2830.4932	(238)
10a. Fuel costs - using Ta	ble 12 pr	rices										
		*****			*******		Fuel	1	uel price		Fuel cost	
Space heating - main syste	em 1						kWh/year 3226.8862		p/kWh 13.1900		£/year 425.6263	3 (240)
Space heating - secondary							0.0000		0.0000		0.0000	1 (242)
water heating (other fuel) Mechanical ventilation fam	IS						113.6721		13.1900		14.9933	3 (249)
Pumps and fans for heating							30.0000		13.1900		3.9570) (249)
Pump for solar water heati	ng						50.0000		13.1900		6.5950) (249)
Energy for lighting Additional standing charge	s						422.8324		13 1900		55.7716	(250) (251)
Energy saving/generation t	echnologi	les										
PV Unit		AVP.					-1727.2394		13.1900		-227.8229	(252)
Total energy cost											373.3423	(255)

 11a. SAP rating - Individual heating systems
 0.4200 (256)

 Energy cost deflator (Table 12):
 0.4200 (256)

 Energy cost factor (ECP)
 [(255) x (256)] / [(4) + 45.0] =

 SAP value
 85.5359

 SAP rating (Section 12)
 86 (258)

 SAP band
 B

	Energy	Emission factor	Emissions	
	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3226.8862	0.5190	1674.7539 ((261)
Space heating - secondary	0.0000	0.0000	0.0000 ((263)
Water heating (other fuel)	714.3419	0.5190	370.7435 ((264)
Space and water heating			2045.4974 ((265)
Pumps and fans	193.6721	0_5190	100.5158 ((267)
Energy for lighting	422.8324	0.5190	219.4500 ((268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372 ((269)
Total kg/year			1469.0260 ((272)
CO2 emissions per m2			13.8300 ((273)
EI value			86.9834	
EI rating			87 ((274)
EI band			В	

CALCULATION DETAILS for survey reference no 'ASHP' CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

CALCULATION DETAILS for survey reference no 'ASHP' 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 EFC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

		Area	Store	y height			Volume			
		(m2)		(m)			(m3)			
Ground floor		41.1800 (1b)	x	2.7000	(2b)	-	111.1860	(1b)	- (3	sb)
First floor		40.3200 (1c)	x	2.7000	(2c)	=	108.8640	(1c)	- (3	sc)
Second floor		24_7300 (1d)	x	1.9800	(2d)	-	48.9654	(1d)	- (3	(ba
Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le). (ln)	106.2300							(4)		
Dwelling volume		(3a)+(3	b) + (3c)	+(3d)+(3e)	(3n)	-	269.0154	(5)		

2. Ventilation rate

					main heating	se	condary heating	3	other	tota	1 m3	ger hour	
Number of chin	meys				0	+	0		0	*	0 * 40 =	0.0000	(6a)
Number of open	1 flues				0	+	0	+	0		0 * 20 =	0.0000	(6b)
Number of inte	ermittent fa	ans									0 * 10 =	0.0000	(7a)
Number of pass	sive vents										0 * 10 =	0.0000	(7b)
Number of flue	eless gas fi	ires									0 * 40 =	0.0000	(7c)
											Air changes	per hour	
Infiltration of Pressure test	lue to chim	neys, flues	and fans	= (6a)+(6b))+(7a)+(7b)+	+(7c) =				0.000	/ (5) =	0.0000 Yes	(8)
Measured/desig	jn q50											5.0000	
Infiltration in Number of side	rate es sheltered	1										0.2500	(18) (19)
Shelter factor									(20) = 1	- [0.075 x	(19)] =	0.8500	(20)
Infiltration 1	cate adjuste	ed to includ	le shelter f	actor						(21) = (18) 5	c (20) =	0.2125	(21)
	Jan	Feb	Mar	Apr	May	Tun	Jul	Aug	Sen	Oct	Nov	Dec	
Wind speed	4 3000	4 2000	4 1000	3 9000	3 9000	3 4000	3 6000	3,4000	3 4000	3 7000	3 6000	4 0000	(22)
Wind factor Adj infilt rat	1.0750 e	1.0500	1.0250	0.9750	0.9750	0.8500	0,9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
	0.2284	0.2231	0.2178	0.2072	0.2072	0.1806	0.1913	0.1806	0.1806	0.1966	0.1913	0.2125	(22b)
Mechanical ext	ract ventil	lation - dec	entralised										
If mechanical	ventilation	1:										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	Opening	IS No	etArea	U-value	A	CU I	K-value	AxB	b
				m2	m2		m2	W/m2K	W/	K I	J/m2K	kJ/K	
Opening Ty	pe 1 ($Uw = 1.6$	50)				15	.2000	1.5038	28.87	722			(27)
Opening Ty	pe 2					4	2.2100	3.0000	6.63	300			(26)
Opening Ty	pe 3 (Uw = 1.6	50)					.3100	1.5038	1,96	599			(27a)
Heat Loss	Floor 1					4	L.1800	0.1800	7.41	124			(28a)
Wall 1				124.7400	21.410	10 10:	3.3300	0.2400	24.79	92			(29a)
Wall 2				11.3400		13	.3400	0.3200	3.62	88			(29a)
Wall 3				20.8000		20	0.8000	0.1500	3.12	200			(29a)
External R	oof 1			33,6300	1,310	0 3:	2.3200	0.1500	4.84	80			(30)
External R	oof 2			5.4000			5.4000	0.1300	0.70	20			(30)
External R	oof 3			15.5900		1	5-5900	0.1600	2.49	944			(30)
Total net	area of extern	nal elements	Aum (A, m2)			253	2.6800						(31)
Fabric hea	t loss, W/K =	Sum (A x U)					(26)	(30) + (32)	= 84.47	69			(33)
Thermal ma	ss parameter)	(TMP = Cm /	TFA) in kJ/	m2K								100.0000	(35)
Thermal br	idges (Default	value 0.15	0 * total e	exposed area)							37.9020	(36)
Total fabr	ic heat loss									(33)	+ (36) =	122.3789	(37)
Ventilatio	n heat loss ca	alculated mo	onthly (38) m	1 = 0.33 x (25)m x (5)								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.3875	44.3875	44.3875	44.3875	44.3875	44,3875	44.3875	44.3875	44.3875	44.3875	44.3875	44.3875	(38)
Heat trans	fer coeff												
	166.7664	166.7664	166.7664	166.7664	166.7664	166,7664	166.7664	166.7664	166.7664	166.7664	166.7664	166.7664	(39)
Average = 3	Sum(39)m / 12	e										166.7664	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5699	1.5699	1.5699	1.5699	1.5699	1.5699	1.5699	1.5699	1,5699	1,5699	1.5699	1.5699	(40)

HLP (average) Days in month 31 28 31 30 31 30 31 31 30 31 30 31 (41)

								110110010				
4. Water heat:	ing energy	requirement	s (kWh/year	2								
Assumed occupa	ancy											2.7902 (42)
Average daily	hot water	use (litres	(day)									100.4673 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot wate	er use											
	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140 (44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106,7731	98.9410	113.5362	114.8922	133.8958	146,1577	158.7178 (45)
Energy content	(annual)									Total = S	um (45) m =	1580.7412 (45)
Distribution 1	loss (46) m	= 0.15 x (45)m									
	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077 (46)
Water storage	loss:											
Store volume												125.0000 (47)
a) If manufac	cturer decl	ared loss f	actor is know	own (kWh/d	ay):							1.7000 (48)
Temperature 1	factor from	Table 2b										0.5400 (49)

CALCULATION DETAILS for survey reference no 'ASHP'		
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING	09 Jan 2014	Page: 30 of 32

Enter (49) or	c (54) in (5	55)										0.9180	(55)
Total storage	e loss												
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28 4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder o	contains dec	dicated sola	ir storage										
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28,4580	27.5400	28.4580	27.5400	28,4580	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10,2355	11.1660	17.1091	21,8667	22 5120	23 2624	(59)
Total heat re	equired for	water heati	ng calculat	ted for each	month								
	215.6094	190.0536	198.2371	172.2520	162.6601	144 2184	137 6344	153 1602	159.5413	184.2204	196.2097	210.4382	(62)
Aperture area	a of solar o	collector										3.0000	(H1)
Zero-loss col	llector effi	iciency										0.7000	(H2)
Collector hea	at loss coel	fficient										1.8000	(H3)
Collector 2nd	d order heat	t loss coeff	icient									0.0050	(H3a)
Collector eff	fective heat	t loss coeff	licient									1.8063	(H3b)
Collector per	formance ra	atio										2.5804	(H4)
Annual solar	radiation m	per m2										1117.3717	(H5)
Overshading 1	factor											0.8000	(H6)
Solar energy	available											1877 1845	(H7)
Adjustment fa	actor for sh	nowers										1.0000	(H7a)
Solar-to-load	i ratio											1,1875	(H8)
Utilisation 1	factor											0,5692	(H9)
Collector per	formance fa	actor										0.8793	(H10)
Dedicated sol	lar storage	volume										75,0000	(H11)
Effective sol	lar volume											75 0000	(H13)
Daily hot wat	ter demand											100,4673	(H14)
Volume ratio	Veff/V											0.7465	(H15)
Solar storage	e volume fac	ctor										0.9415	(H16)
Solar input												-884.5663	(H17)
Solar input	-26.8138	-40,2066	-68.8048	-95.2656	-114.5952	-120.3077	-118.4067	-106.0626	-83.0662	-56.1605	-32.8532	-22.0234	(63)
active subset	2010000		0.00000.000	0.02312555				Solar input	(sum of a	months) = Su	um(63)m =	-884.5663	(63)
Output from a	e/h												
oucput room	188 7956	149 8470	129 4322	76.9864	48.0650	23,9106	19,2277	47.0975	76.4751	128.0599	163.3565	188.4148	(64)
	200-1000			1.000			Construction of the	Total per	year (kW)	h/year) = Su	um(64)m =	1239.6684	(64)
Heat gains fo	com water be	eating, kwh/	month										
man Jarup Ti	DE DEDA	BE 0222	89 4406	77 5159	72 2824	65 4583	63 8526	69 4499	73 9209	84.7801	88.6390	94.1500	(65)

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

Metabolic gains (Table 5), Watts

 Jan
 Feb
 Mar
 Apr
 May
 Jun

 (66)m
 167.4120
 167.4120
 167.4120
 167.4120
 167.4120

 Lighting gains
 (calculated in Appendix L, equation L9 or L9a), also see Table 5
 59.8563
 53.1638
 43.2357
 32.7322
 24.4677
 20.6567
 Jan Feb 167.4120 167.4120 Jul Sep Oct Nov Dec Aug 167.4120 167.4120 167.4120 167.4120 167.4120 167,4120 (55) Lighting gains (calculated in Appendix L, equation L9 of Dav), also see table 5 59.8563 53.1638 43.2357 32.7322 24.4677 20.6557 22.3203 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 397.0508 401.1710 390.7883 368.6850 340.7834 314.5598 297.0409 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 22,3203 38.9408 49.4443 57.7088 61.5199 (67) 29.0127 292.9208 303.3034 325.4068 353.3084 379.5319 (68) 54.5314 54.5314 54.5314 (69) 54.5314 54.5314
 54,5314
 54,5314
 54,5314
 54,5314

 Pumps, fans
 3,0000
 3,0000
 3,0000

 Losses e.g. evaporation (negative values) (Table 5)
 3.0000 3 0000 3 0000 3 0000 3.0000 (70) 699 0993 694 2062 667 5753 622 4134 575 7403 539 4662 518 5200 528 6156 558.2476 602 1382 647.4624 680.9329 (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	1.2000	11.5683	0.7200	0.7000	0.7700	4.8485 (74)
East	18.0000	21.5704	0.7200	0.7000	0.7700	135.6105 (76)
South	1.3100	29.0000	0_7200	0.7000	1.0000	17.2323 (82)
	**********************************		******			
			027 0264 070 0502	771 0000 504 0754	362 0738 203 379	8 127 1094 (83)

Solar gains 157,6514 278,5330 464,2402 705,0441 840,4422 527,0264 879,3502 771,0886 554,3254 562,0736 125,5766 127,4057 (057) Total gains 856,7907 972,7392 1131,8156 1327,4575 1422,1826 1467,2926 1398,4702 1299,7045 1153,1730 964,2121 850,8422 808,0422 (84)

7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9. Th1 (C) Utilisation factor for gains for living area, ni1,m (see Table 9a) Jan Feb Mar Apr May Jun tau 17.6944 17.6944 17.6944 17.6944 17.6944 17.69 21.0000 (85) Oct 17.6944 2.1796 Jun 17.6944 Jul 17.6944 Aug 17.6944 Sep 17.6944 Nov Dec 17.6944 2.1796 17.6944 2.1796 2.1796 2.1796 2.1796 2.1796 2.1796 alpha 2.1796 2.1796 2.1796 2 1796 util living area 0.9386 0.9189 0.8689 0.7768 0.6405 0.4457 0.2828 0.3232 0.5976 0.8166 0 9121 0 9447 (86) 20,1103 19.4183 18.8535 (87) 20.7714 20.6448 20.8540 20.8443 18.8984 19 0889 19 5548 20 0666 20 5034 MIT MI1 Th 2 19.635 util rest of house 0.9279 19.6355 19.6355 19.6355 19 6355 19.6355 19.6355 19.6355 19.6355 19.6355 19.6355 19.6355 (88) 19.6355 0.7705 0.8937 0.9349 (89) 0.5677 0.1339 0.1683 0.4919 0.3312 0.9048 0.8450 0.7348 MIT 2 17.6651 16.8522 (90) 0.3295 (91) 17.5116 (92) 0.0000 16.9158 17.1870 17.8464 18.5478 19.1094 19.3972 19.4532 19.4502 19.2865 18.6300 fLA = Living area .7340 19.1177 (4) = 18.2428 Living area fraction 19.7340 19.5687 19.8500 19.9148 19,9095 17.8136 19.0482 MIT 17.5690 18.4093 Temperature adjustment 17.5116 (93) 17.5690 17.8136 18,4093 19.0482 19.5687 19.8500 19 9148 19 9095 19 7340 19,1177 18,2428 adjusted MIT

8. Space heating requirement

Jul 0.1658 Sep 0.5005 577.2082 Jun 0.3506 Aug 0.2012 Oct Nov May Dec Feb Mar Apr Jan Useful gains 776.0027 Ext temp. 5.4000 Heat loss 0.9139 (94) 738.4475 (95) 5.4000 (96) 0.7134 0.7489 0.8688 0.5637 0.8800 0.8182 926.0095 514,4459 231.8653 261.5287 856.0041 801.7086 5.9000 10.4000 13.5000 16.5000 18.5000 18.3000 15.6000 12.1000 8.4000 2029.3826 1986.7896 1752.5937 1442.2244 1012.0473 Month fracti 1.0000 1.0000 1.0000 1.0000 1.0000 Space heating kWh 1641.4437 2019.8014 (97) 0 1.0000 1.0000 (97a) 558.6634 235.9346 268.4171 689.4173 1170.3158 1.0000 0.0000 0.0000 0.0000 0.0000 1 0000

CALCULA	ATION DE	TAILS for s EPC COS	survey refe TS, EMIS	erence no ' SIONS AN	ASHP' D PRIMAR	Y ENERG	Y FOR IM	PROVED	DWELLIN	IG 09 J	an 2014		Page: 31 of 3
Space heating	932 5146 g g per m2	759.8879	614.9786	356.5356	156,4920	0.0000	0.0000	0.0000	0.000	333.4429 (9	649.6372 8) / (4) =	953.3273 4756.8163 44.7785	(98) (98) (99)
8c. Space co Not applicab	oling requir le	rement											
9a. Energy r	equirements	- Individua	al heating	systems, inc	luding micr	0-CHP	******					0.0000	(201)
Fraction of a Fraction of a Efficiency of Space heating	space heat i space heat i f main space f secondary, g requiremen	from main sy e heating sy /supplementa nt	ystem(s) ystem 1 (in ary heating	<pre>%) system, %</pre>	an (lable li	r						1.0000 175.1000 0.0000 2716.6283	(202) (206) (208) (211)
Space beating	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct.	Nov	Dec	
Space heating	932.5146 a efficiency	759.8879 / (main heat	614.9786	356.5356	156.4920	0.0000	0.0000	0.0000	0.0000	333.4429	649,6372	953,3273	(98)
Space heating	g fuel (main	175.1000 heating sy	175.1000 /stem)	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175,1000	175.1000	(210)
Water heating	532.5612 g requiremen	433_9737 nt	351.2157	203.6183	89,3729	0.0000	0.0000	0.0000	0.0000	190.4300	371.0093	544,4473	(211)
	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	g g requiremen	149 8470	129 4333	TE GREA	48 0650	23 9106	19 2277	47 0975	76 4751	128 0599	163 3565	188 4149	(64)
Efficiency of (217)m	f water heat 175 1000	149.8470 ter 175.1000	175,1000	175,1000	175,1000	175,1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216) (217)
Fuel for wate	er heating, 107.8216	kWh/month 85.5779	73.9190	43.9671	27.4500	13.6554	10.9810	26_8975	43.6751	73.1353	93.2933	107.6041	(219)
Water heating Annual totals Space heating Space heating	g fuel used s kWh/year g fuel - mai g fuel - sec	in system condary										707.9774 2716.6283 0.0000	(219) (211) (215)
Electricity (MEVDecent mechanical central hea pump for so	for pumps an tralised, Da ventilation ating pump olar water b	nd fans: atabase: tot 1 fans (SFP neating	tal watage ≠ 0.	= 12.8150, t 3464)	otal flow =	37,0000, SI	FP = 0.3464)				113.6721 30.0000 50.0000	(230a) (230c) (230g)
Total electr: Electricity 1	icity for th for lighting	ne above, kW g (calculate	Wh/year ed in Appen	dix L)								193.6721 422.8324	(231) (232)
Energy saving PV Unit 0 (0 Total delives	g/generation .80 * 2.50 * red energy 1	n technologi • 1117 * 0.8 for all uses	ies (Append 30) = 3	icės M ,N an	iđ Q)					-1787 7948		-1787.7948 2253.3154	(233) (236)
10a. Fuel cos	sts - using	BEDF prices	(387)										
								Fuel kWh/year	I	Fuel price		Fuel cost	
Space heating	g - main sys	stem 1						2716.6283		15.3200		416.1875	(240)
Water heating	g (other fue	el) fans						707.9774		15.3200		108.4621	(247) (249)
Pumps and fai	ns for heati	ing						30.0000		15.3200		4.5960	(249)
Energy for 1: Additional st	ighting tanding char	rges						422.8324		15.3200		64.7779 0.0000	(250) (251)
Energy saving PV Unit	g/generation	n technologi	les					-1787.7948		15.3200		-273.8902	(252)
Total energy	cost											345.2079	(255)
12a. Carbon (dioxide emis	ssions - Ind	lividual he	ating system	s including	micro-CHP							
								Energy kWh/year	Emissi k	ion factor tg CO2/kWh	kg	Emissions CO2/year	
Space heating Space heating	g - main sys g - secondar	stem 1 ry						2715.6283		0.5190		1409.9301 0.0000	(261) (263)
Water heating Space and wat	g (other fue ter heating	21)						707.9774		0.5190		367.4403	(264) (265)
Pumps and far Energy for 1:	ns ighting							193.6721 422.8324		0.5190 0.5190		100.5158 219.4500	(267) (268)
Energy saving PV Unit Total kg/year	g/generatior r	n technologi	ies					-1787.7948		0.5190		-927.8655 1169.4707	(269) (272)
						ميدسين							
13a, Primary	energy - Ir	ndividual he	eating syst	ems includin	g micro-CHP			Enermy D	rimary enco	ray factor	Prim	ITV energy	
Space heating	a - main au	stem 1						kWh/year 2716 6283	a runary ener	kg CO2/kWh 3.0700	FIIMa	kWh/year 8340.0489	(261)
Space heating	g - secondar g (other for	ry •1)						0.0000		0.0000		0.0000	(263) (264)
Space and wat	ter heating							193.6721		3.0700		10513.5395	(265) (267)
Energy for 1:	ighting							422.8324		3.0700		1298.0954	(268)
Energy saving PV Unit Primary energy	g/generation gy kWh/year	1 technologi	ies					-1787 7948		3.0700		-5488.5299 6917.6782	(269) (272)

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CALCULATION DETAILS for surve CALCULATION OF EPC COSTS, E	MISSIONS	ND PRIMARY	ENERGY FOR I	MPROVED DWELL	ING 09 Jan 2014		Page: 32 of 32
Primary energy kWh/m2/year						65.1198	(273)
rings) chord) how may here							12.17
SAP 2012 OVERHEATING ASSESSMENT FOR New	Build (As Des	igned) 9.92					
Overheating Calculation Input Data	-110-110-110-11						
Dwelling type Number of storeys Cross ventilation possible SAP Region Front of dwelling faces Overshading Overshading parameter Night ventilation Ventilation rate during hot weather (ach)	Detached F 3 Yes Thames Val North Average or 100.0 Yes 4.00 (Wind	kouse ley unknown Nows half open)				
Overheating Calculation Summer ventilation heat loss coefficient						355.10	(P1)
Transmission heat loss coefficient Summer heat loss coefficient						122.38 477.48	(37) (P2)
Overhangs Orientation			Ratio	Z_overhangs		Overhang type	
North East			0.000	1_000 1.000	None		
Solar shading Orientation			Z blinds	Solar access	Z overhangs	Z summer	
North			1.000	0.90	1.000	0.900	(P8)
East			1.000	0.90	1.000	0.900	(P8)
South			1.000	1.00	1.000	1.000	(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	
Marth	1 2000	01 1057	0.7200	0.7000	0.9000	19 7716	
East	18,0000	117.5071	0.7200	0.7000	0.9000	863.4795	
South	1.3100	203.0000	0.7200	0.7000	1.0000	120.6258	
total:		********		*********		1023.8770	
			Jun	Jul	Aug		
Solar gains			1089	1024	895		(P3)
Internal gains Total summer gains			550 1639	530 1553	539 1433		(P5)
Summer gain/loss ratio			3.43	3.25	3.00		(P6)
Summer external temperature			16.00	17.90	17.80		201
Thermal mass temperature increment (TMP :	= 100.0)		1.30	1.30	1.30		(and
Threshold temperature			20.73 Slight	22.45 Medium	22.10 Medium		(27)
streatmood of might incernat cemperature			DITAIL	PIC LL LLIN	PIC GL GIU		

Assessment of filefillood of high internal temperature: Medium

Johns Slater and Haward......13 + 13A West Hampstead Mews – Energy Report.......March 2016.......EB/5223/ES/A

APPENDIX 2

13+13A WEST HAMPSTEAD MEWS

BRUKL REPORTS FOR COMMERCIAL UNIT (BE LEAN)

BRUKL Output Document

Compliance with England Building Regulations Part L 2013

Project name

West Hampsted Mews - Improved COP -Zone 1

As designed

HM Government

Date: Fri Feb 26 09:00:25 2016

Administrative information

Building Details

Address: West Hampsted Mews, London, NW6 3BB

Certification tool

Calculation engine: TAS Calculation engine version: "v9.3.3" Interface to calculation engine: TAS Interface to calculation engine version: v9.3.3 BRUKL compliance check version: v5.2.d.2

Owner Details Name: Telephone number: Address: , ,

Certifier details Name: Telephone number: Address: , ,

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

CO2 emission rate from the notional building, kgCO2/m2.annum	18.7
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	18.7
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	16.2
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. Building fabric

Element	Ua-Limit	Ua-Calc	Ui-Calc	Surface where the maximum value occurs'
Wall**	0.35	0.17	0.17	External Wall
Floor	0.25	0.15	0.22	Exposed Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.5	1.59	Stairwell Rooflight
Personnel doors	2.2	1.55	1.61	Rooflight Access Doors (1)
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	1.97	1.97	GF ENTRANCE DOOR
Used imit = 1 imiting area-weighted average 11-values M	//(m ² K)]	-		

Ua-calc = Calculated area-weighted average U-values [W/(m²K)]

Ui-calc = Calculated maximum individual element U-values [W/(m²K)]

* 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
m³/(h.m²) 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- Comfort Cooling - Supply and Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency
This system	0.98	4,42	k:	1.1	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.5

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES

* Standard shown is for gas single boiler systems <= 2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1-Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.98	0
Standard value	0.9*	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	Lumino	ous effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Ground Floor Office		-	+	338386
First Floor Office	-	-	-	303327
Second Floor Office	-	-	-	171780
Kitchenette	-	-		40137
Second Floor Store	-	-	-	726
Ground Floor WC		(en	-	4266
Ground Floor Acc WC	(+)	-	÷	7880
First Floor MWC	-	-	-	4266
First Floor FWC	-	-	-	4343
Second Floor MWC	÷	-	-	4266
Second Floor FWC		-	÷	5696
Entrance / Corridor / Stairs	-	-	-	18615

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?
Ground Floor Office	NO (-81%)	NO
First Floor Office	NO (-79%)	NO
Second Floor Office	YES (+409%)	NO

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?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional	%
Area [m ²]	339	339	
External area [m ²]	712	712	
Weather	LON	LON	100
Infiltration [m3/hm2@ 50Pa]	3	3	
Average conductance [W/K]	424	266	
Average U-value [W/m ² K]	0.6	0.37	
Alpha value* [%]	11.96	11.96	

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

Building Use

% Area Building Typ

rea	1211			Type	
Sec. Allo	100 C	-		- Andrews	
	10 212 2	201 100	6	Links	 1

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 Inst.: Hospitals and Care Homes
- C2 Residential Inst.: Residential schools
- C2 Residential Inst.: Universities and colleges
- C2A Secure Residential Inst.
- Residential spaces
- D1 Non-residential Inst.: Community/Day Centre
- D1 Non-residential Inst.: Libraries, Museums, and Galleries
- D1 Non-residential Inst.: Education
- D1 Non-residential Inst.: Primary Health Care Building
- D1 Non-residential Inst.: 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
9.04	4.16
6.35	9.6
2.71	3.47
17.07	20.73
3.11	3.17
41.87	41.87
38.28	41.15
	Actual 9.04 6.35 2.71 17.07 3.11 41.87 38.28

* Energy used by equipment does not count towards the total for 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]	125.93	143.93
Primary energy* [kWh/m ²]	95.05	110.16
Total emissions [kg/m ²]	16.2	18.7

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

	HVAC Sys	stems Pei	formanc	е						
Sy	stem Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[S	T] Central h	eating using	g water: rad	iators, [HS]] LTHW boi	ler, [HFT] N	latural Gas	, [CFT] Ele	ctricity	
	Actual	30.2	95.7	9.5	6.7	5	0.88	3.98	0.98	4.42
	Notional	12.8	131	4.4	10.1	4.7	0.82	3.6		

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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

U і-тур	Ui-Min	Surface where the minimum value occurs
0.23	0.17	External Wall
0.2	0.15	Ground Floor
0.15	0.15	Roof
1.5	1.47	Lightwell Vertical
1.5	1.52	Rooflight Access Doors
1.5	4	No vehicle doors in project
1.5	1.97	GF ENTRANCE DOOR
	Ui-тур 0.23 0.2 0.15 1.5 1.5 1.5 1.5 1.5	Ui-Typ Ui-Min 0.23 0.17 0.2 0.15 0.15 0.15 1.5 1.47 1.5 1.52 1.5 - 1.5 1.97

* 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	

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APPENDIX 3

13+13A WEST HAMPSTEAD MEWS

BRUKL REPORTS FOR COMMERCIAL UNIT (BE GREEN)

BRUKL Output Document HM Government Compliance with England Building Regulations Part L 2013

Project name

1.3.16 - West Hampsted Mews - Improved **U-values**

Date: Tue Mar 01 16:18:41 2016

Administrative information

Building Details Address: West Hampsted Mews, London, NW6 3BB

Certification tool

Calculation engine: TAS Calculation engine version: "v9.3.3" Interface to calculation engine: TAS Interface to calculation engine version: v9.3.3 BRUKL compliance check version: v5.2.d.2

Owner Details Name: **Telephone number:** Address: , ,

Certifier details Name: **Telephone number:** Address: , ,

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

CO2 emission rate from the notional building, kgCO2/m2.annum	18.3
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	18.3
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	18.1
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 the building services should achieve reasonable overall standards of energy efficiency

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

Building fabric

Element	Ua-Limit	Ua-Calc	UI-Calc	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.17	External Wall
Floor	0.25	0.15	0.22	Exposed Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.5	1.59	Stairwell Rooflight
Personnel doors	2.2	1.55	1.61	Rooflight Access Doors (1)
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	1.97	1.97	GF ENTRANCE DOOR
Usitimit = Limiting area-weighted average LL-values M	//(m2k)]		1	1

Ua-calc = Calculated area-weighted average U-values [W/(m²K)]

Ui-cale = Calculated maximum individual element U-values [W/(m²K)]

* 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	
m3/(h.m2) at 50 Pa	10	3	

As designed

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

1- Comfort Cooling - Supply and Extract (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency
This system	4.42	4.42	24 C C C C C C C C C C C C C C C C C C C	1.1	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.5
otandara value	0.01	2.0	INA	1.1	10.5

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- Electric Panel Heating - No Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency
This system	1		-	-	-
Standard value	0.86	N/A	N/A	N/A	N/A
Automatic moni	toring & targeting w	ith alarms for out-of	-range values for th	is HVAC system	n YES

3- Electric Panel Heating - Extract Only (7 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency	
This system	1		-		-	
Standard value	N/A	N/A	N/A	N/A	N/A	
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES						

1- Electric Water Heating

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	0.9*	N/A

shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	Luminous efficacy [lm/W]]
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Ground Floor Office	÷		-	338386
First Floor Office	-	900	-0. :	303327
Second Floor Office	-	1	-	171780
Kitchenette	-	-	£!	40137
Second Floor Store	-	-	-	726
Ground Floor WC	-	4	-	4266
Ground Floor Acc WC	4	-	-	7880
First Floor MWC	+	-	•	4266
First Floor FWC	-		-	4343
Second Floor MWC	-	-	-	4266

General lighting and display lighting	Luminous efficacy [Im/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	and the second second
Second Floor FWC		-	-	5696
Entrance / Corridor / Stairs	-	-	-	18615

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?	
Ground Floor Office	NO (-81%)	NO	
First Floor Office	NO (-79%)	NO	
Second Floor Office	YES (+409%)	NO	

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?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional	% Are
Area [m ²]	405	405	
External area [m ²]	712	712	-
Weather	LON	LON	100
Infiltration [m ³ /hm ² @ 50Pa]	3	3	
Average conductance [W/K]	424	291	
Average U-value [W/m ² K]	0.6	0.41	
Alpha value* [%]	11.96	11.96	
		and the second second second	

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

Building Use

Area Building Type

A1/	A2 Retall/Financial and Professional services
A3/	A4/A5 Restaurants and Cafes/Drinking Est/Takeaways
81	Offices and Workshop businesses
82	to B7 General Industrial and Special Industrial Groups
B8	Storage or Distribution
C1	Hotels
02	Residential Inst.: Hospitals and Care Homes
C2	Residential Inst.: Residential schools
C2	Residential Inst.: Universities and colleges
C2/	A Secure Residential Inst.
Res	idential spaces
D1	Non-residential Inst.: Community/Day Centre
Dt	Non-residential Inst.: Libraries, Museums, and Galleries
01	Non-residential Inst.: Education
D1	Non-residential Inst.: Primary Health Care Building
D1	Non-residential Inst.: Crown and County Courts
02	General Assembly and Leisure, Night Clubs and Theatres
Oth	ers: Passenger terminals
Oth	ers: Emergency services
Oth	ers: Miscellaneous 24hr activities
Oth	ers: Car Parks 24 hrs

Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.11	4.84
Cooling	5.31	7.99
Auxiliary	2.45	3.15
Lighting	17.64	19.82
Hot water	2.33	2.7
Equipment*	37.34	37.34
TOTAL**	34.85	38.51

* Energy used by equipment does not count towards the total for 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]	123.91	131.15
Primary energy* [kWh/m ²]	106.98	103.17
Total emissions [kg/m ²]	18.1	18.3

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

HVAC Sy	stems Pe	rformanc	е						
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or	multi-split sy	stem, [HS]	LTHW boile	er, [HFT] El	ectricity, [C	FT] Electr	icity		A
Actual	27.1	95.5	1.9	6.7	2.9	3.98	3.98	4.42	4.42
Notional	12.6	130.2	1.5	10	3.7	2.43	3.6		
[ST] Other lo	cal room hea	iter - unfann	ned, [HS] D	irect or sto	rage electri	ic heater, [HFT] Electr	icity, [CFT] E	ectricity
Actual	159.3	0	44.2	0	0	1	0	1	0
Notional	94.2	0	32	0	0	0.82	0		
[ST] Other lo	cal room hea	ter - unfanr	ned, [HS] D	irect or stor	rage electri	c heater, [HFT] Electri	icity, [CFT] E	lectricity
Actual	128.7	0	35.8	0	3.8	1	0	1	0
Notional	54.1	0	18.4	0	5	0.82	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 BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U і-тур	UI-Min	Surface where the minimum value occurs	
Wall	0.23	0.17	External Wall	
Floor	0.2	0.15	Ground Floor	
Roof	0.15	0.15	Roof	
Windows, roof windows, and rooflights	1.5	1.47	Lightwell Vertical	
Personnel doors	1.5	1.52	Rooflight Access Doors	
Vehicle access & similar large doors	1.5	-	No vehicle doors in project	
High usage entrance doors	1.5	1.97	GF ENTRANCE DOOR	
U _{i-Typ} = Typical individual element U-values [W/(m ² H * There might be more than one surface where the	()] minimum L	J-value oc	U _{HMin} = Minimum individual element U-values [W/(m ² K)] curs.	

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