Energy & Sustainability Strategy

Proposed Residential and Commercial Development at Land Rear of No. 74 Church Rd, Barnes

Authorisation	Name	Date	Signature
Report prepared by:	Sean Mills	10/08/2016	
Report checked and authorised by:	Pete Mitchell	10/08/2016	

Our Ref: BE0724
Prepared On Behalf Of: Anne Machin Architects

Build Energy Ltd
Unit 6 Silver Business Park
Airfield Way, Christchurch, Dorset BH23 3TA
T: 01202 280062
E: info@buildenergy.co.uk

Contents Page

1. Executive Summary

1.1.1 This report has been produced on behalf of Anne Machin Architects to form part of the planning application to The London Borough of Richmond Upon Thames for the development at 74 Church Road.

1.1.2 The development consists of six residential units and five commercial units. Build Energy Ltd have been appointed to produce an Energy Strategy Report presenting how the development will comply with the requirements of both the GLA London Plan and The London Borough of Richmond Upon Thames. As required within these documents, a 35% improvement over Part L 2013 of the Building Regulations is to be evidenced. The strategy is based on the Mayor of London's Energy Hierarchy, as follows:

- Use less energy (Be Lean)
- Supply energy efficiently (Be Clean)
- Use renewable energy (Be Green)

1.1.3 In order to minimise the use of energy by this development, a low carbon approach for the design of the building's fabric and associated systems has been used.

1.1.4 The fabric has been designed to be highly air tight, with a Design Air Permeability rate of 4.0 m^3/hm^2 and the use of Accredited Construction Details throughout.

1.1.5 The use of gas fired Combined Heat and Power (CHP) and boiler units has been considered but for a development of this scale and heat demand, it has been deemed inappropriate. The potential to connect to an existing heat network has been investigated and no opportunities exist at present.

1.1.6 The use of photovoltaic solar panels has been identified as the optimum strategy for lowering CO_2 emissions over and above the improvements achieved through fabric and building services efficiency. A system of c.a. 0.7kWp per domestic plot and c.a. 1.25kWp to serve the commercial premises facing south east and south west at 15° will be required to meet the London Plan target.

1.1.7 It has been identified that these measures have resulted in an average reduction in CO_2 emissions of 35.88% when measured against Part L 2013 Building Regulations.

2. Introduction

2.1.1 Anne Machin Architects are proposing to submit a planning application to The London Borough of Richmond Upon Thames for the development at 74 Church Road.

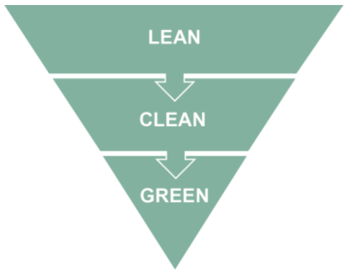
2.1.2 The proposed development at 74 Church Road comprises six residential units and five commercial units.

2.1.3 Build Energy Ltd have been appointed to produce a site-wide Energy Strategy report identifying how the development will address the policies set out by both the Greater London Authority's 'London Plan' document and The London Borough of Richmond Upon Thames. In line with these policies, the development must achieve the following measures of sustainability:

- A 35% reduction over the baseline in line with the energy hierarchy.

2.1.4 The strategy is based on the Energy Hierarchy, as follows:

- Use less energy (Be lean)
- Supply energy efficiently (Be clean)
- Use renewable energy (Be green)



2.1.5 The use of passive design and energy efficient features are key to reducing energy demand. The proposed energy efficiency measures include a well-insulated building fabric, alongside a ventilation strategy that aims to maximise heat recovery. These measures will go some way towards achieving compliance, however, Low or Zero-Carbon (LZC) energy technologies will be required in order to demonstrate compliance with requirements set out under relevant planning policy. The strategy is based on information provided by the project design team.

2.1.6 The embodied energy of the development is out of the scope of this report. The focus will be on delivered energy demand.

3. Planning Policy Guidance & Legislation Affecting 74 Church Road

3.1 *Relevant Local and Greater London Policy*

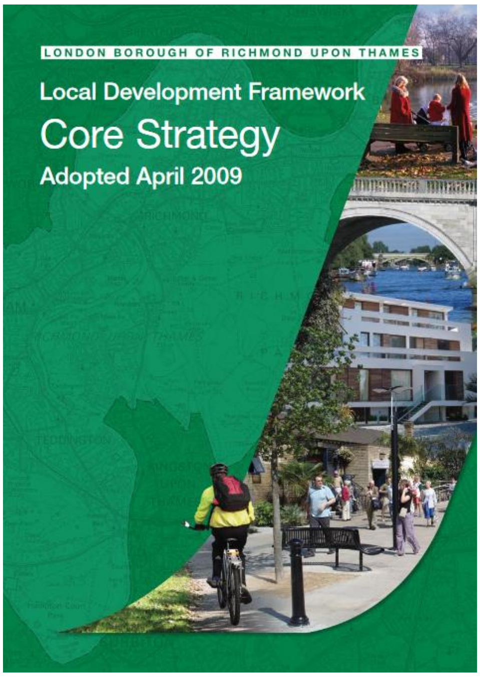
3.1.1 The following policies will apply to the development;

London Plan 2015:

- Mayor of London SPD on Sustainable Design and Construction
- Policy 5.2 – Minimising Carbon Dioxide Emissions
- Policy 5.3 – Sustainable Design & Construction
- Policy 5.5 – Decentralised Energy Networks
- Policy 5.9 – Overheating and Cooling
- Policy 5.15 – Water Use and Supplies

The London Borough of Richmond Upon Thames:

- Local Development Framework – Core Strategy



3.2 *Establishing Carbon Reduction Requirements*

3.2.1 The Town and Country Planning (Development Management Procedure) (England) Order 2010 defines a minor residential development of consisting of nine dwellings or less. For all other uses, a minor development is one where the floor space to be built is less than 1,000 square metres or where the site area is less than 1 hectare.

3.2.2 The development proposed by Anne Machin Architects at 74 Church Road consists of less than ten dwellings, has a total floor area of less than 1,000 square metres and a site area is less than 1 hectare. As such is it is considered a minor development.

3.2.3 The carbon emissions of dwellings and non-dwellings created through refurbishment and through new construction are assessed under separate Building Regulations, known collectively as Part L. The relevant building regulations for the project at 74 Church Road are:

- Approved Document L1A: Conservation of fuel and power in new dwellings (2013 edition with 2016 amendments).
- Approved Document L2A: conservation of fuel and power in new buildings other than dwellings, 2013 edition with 2016 amendments.

3.2.4 Under Part L1a of the Building Regulations, new build homes are expected to reduce carbon emissions such that the Dwelling Emissions Rate (DER) falls below the Target Emissions Rate (TER), as measured through SAP.

3.2.5 Under Part L2a of the Building Regulations, new build non dwellings are required to reduce carbon emissions so that the Dwelling Emissions Rate (DER) falls below the Building Emissions Rate (BER). This is measured through SBEM calculations and BRUKL reporting.

3.2.6 The Greater London Authority Guidance on Preparing Energy Statements (March 2016) requires that major new build developments exceed the building regulations target by a further 35% on site, following the stages of the Energy Hierarchy. It is the at the discretion of Local Authority's to set further reduction targets for minor schemes where no GLA target exists.

3.2.7 The London Borough of Richmond Upon Thames has set a target of 35% within its 'Supplementary Planning Document Sustainable Construction Checklist Guidance Document'. This is described as follows: 'The existing London Borough of Richmond upon Thames policy DM SD 1 contained within the Development Management Plan and the London Plan (2015) require developments to reduce CO2 emissions by 35% beyond Building Regulations 2013'.

3.2.8 The carbon reduction requirements for the development proposed by Anne Machin Architects at 74 Church Road are therefore as follows:

- A 35% reduction over Part L of the Building Regulations in line with the energy hierarchy.

3.3 *Establishing Required Methodologies*

3.3.1 This report has been produced in consultation with the Greater London Authority's 'Energy Planning - Guidance on Preparing Energy Statements – April 2015'.

3.3.2 The Greater London Authority requires that figures for carbon emissions produced by SAP or SBEM software in kg/CO2/annum are converted into tonnes/CO2/annum for comparison between stages of the Energy Hierarchy.

3.3.3 The London Borough of Richmond Upon Thames has produced 'Energy Statement Guidelines for Developers' within its 'Supplementary Planning Document – Sustainable Construction Checklist Guidance Document (Adopted January 2016)'. These documents outline a different methodology, however in correspondence with The London Borough of Richmond Upon Thames it has been confirmed that the London Plan methodology is preferred.

4. Energy Strategy Objective

4.1.1 The purpose of this energy strategy is to demonstrate that climate change mitigation measures have been fully considered and appropriately selected and specified as part of the scheme's design.

4.1.2 In accordance with the guidance notes, after establishing the baseline energy demand and profile for the site, the strategy for the development at 74 Church Road follows the Mayor's Energy Hierarchy (Use Less Energy – 'Be Lean', Supply Energy Efficiently – 'Be Clean' and Use Renewable Energy – 'Be Green') in appraising appropriate measures to reduce carbon emissions and other climate impacts from the development.

4.1.3 The following sections provide more details on each of the steps of the Energy Strategy following the London Plan's Energy Hierarchy. These are illustrated in the attached appendices of this report.

4.1.4 Within the London Plan, the energy hierarchy establishes the baseline energy use of the proposed development and then applies potential energy measures within the structure of the 'Energy Hierarchy'. The stages of the hierarchy are defined as follows:

Use Less Energy – 'Be Lean'	Reduce use through behaviour change Improve insulation Incorporate passive heating Install Energy Efficient lighting and appliances
Supply Energy Efficiently – 'Be Clean'	Use efficient heating equipment
Use Renewable Energy – 'Be Green'	Install renewables on site Import renewable energy

4.2 *Methodology*

4.2.1 Energy demand is estimated for the base case Target Emissions Rate (TER) and then improved through energy efficiency. Low and zero-carbon energy technology can then be applied to further enhance performance to meet the target.

4.2.2 Government approved software (SAP and SBEM) has been used to calculate energy consumption based on current SAP methodology (2013).

4.2.3 All proposed commercial space and a sample of two domestic plots within this development have been modelled.

5. Energy Strategy

5.1 *Baseline Energy Assessment*

5.1.1 Before energy efficiency measures are investigated, it is important to establish the baseline carbon emissions of the development, for comparison and evaluation of energy and efficiency proposals for the development.

5.1.2 The average Part L 2013 compliant carbon emissions can be viewed in the baseline tables in the appendixes of this report.

5.2 *Be Lean*

5.2.1 The primary focus for providing an energy efficient development is driven through the generation of a design that takes advantage of energy use reduction through improved building fabric and engineering services.

5.2.2 The energy demand of the development will be reduced through incorporation of measures including high levels of thermal insulation, detailing to reduce air permeability, construction details at junctions that reduce thermal bridging, and the use of low-energy lighting.

5.2.3 The use of building fabric specifications that better the minimum requirements of Part L as well as maximising daylight will allow for the reduction in the need for heating and lighting through better building design.

5.3 *Be Clean*

5.3.1 The next step in the energy hierarchy is the 'be clean' strategy of supplying the required energy, after all possible passive energy efficiency measures have been incorporated, as efficiently as possible.

5.3.2 The London Plan places great emphasis on decentralised energy generation (DE) using such technologies as CHP. All of the London Boroughs have over the course of several years been producing or commissioning heat map studies to explore the viability of decentralised heat networks. The London Borough of Richmond Upon Thames completed the 'London Borough of Richmond upon Thames - Heat Mapping Study' in 2012. The London Heat Map has also been consulted.

5.3.3 There is currently no identifiable opportunity to connect to an existing or imminent network.

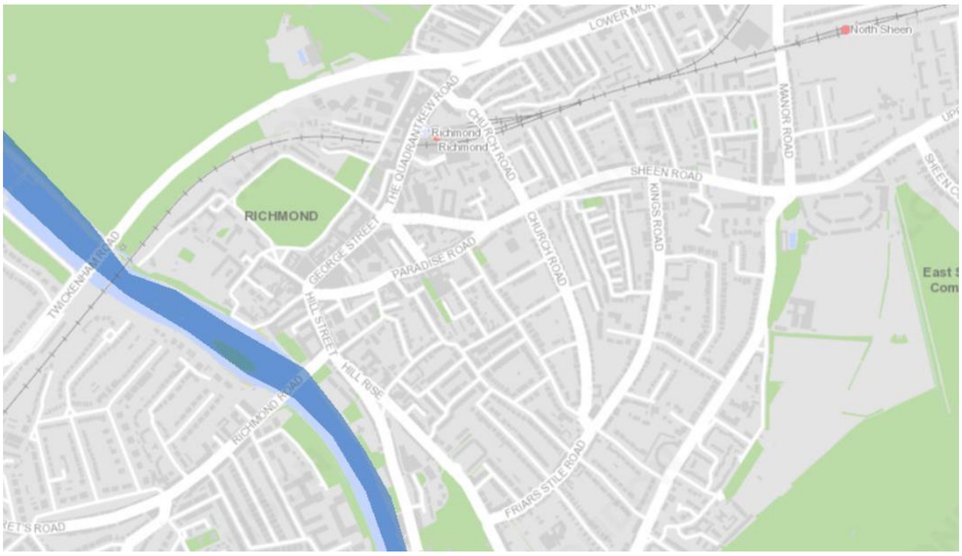


Figure 1 – London Heat Map view of 74 Church Road.

5.3.4 The possibility of connecting to future networks has also been considered, and after consultation with M&E advice it is apparent that the cost of the central plant and distribution and heat interface units is likely to be far in excess of a boiler and gas installation to each dwelling. The running costs are also likely to be higher due to the standing losses, management and maintenance of the central plant.

5.3.5 Combined Heat and Power units (CHP) require significant infrastructure and a substantial heat demand. In order to obtain maximum efficiency, it is necessary to have an energy demand profile which is evenly spread throughout the day and night. A CHP unit will operate efficiently when running continuously and so requires its energy to be used continuously to avoid wastage. This usage profile does not match that of the proposed development and hence a CHP system is not recommended for this site.

5.3.6 Under 'Clean' methodology, all flats have been specified with high efficiency gas boilers (efficiency of 89.5% or greater) and delayed start thermostats. Commercial units have been specified with air source heat pumps as described below.

5.4 *Be Green*

5.4.1 The third and final stage of the energy hierarchy is 'be green'. The potential of a range of renewable energy systems has been assessed to ascertain if their characteristics will be suited to serve the energy requirements of this development and thereby be used to offset CO_2 emissions.

5.4.2 A number of high efficiency or renewable technologies have been reviewed for use in this development. The review of green technologies identifies that the development will be suitable for the inclusion of photovoltaic solar panels providing 1.5kWp to each house.

5.5 *Proposed Specification for 74 Church Road*

5.5.1 Based on this review, the specification of the project at 74 Church Road has been selected to achieve or better the standards identified in Approved Document Part L wherever possible:

Building Fabric Performance:

- U-value of heat-loss floors 0.12 W/m^{2}K
- U-value of heat-loss walls 0.16 W/m^{2}K
- U-value of party walls 0 W/m^{2}K (assumed fully filled cavity with sealed edges or solid)
- U-value of roofs 0.12 W/m^{2}K
- U-value of windows and roof lights 1.4 W/m^{2}K, whole-frame u-value
- U-value of doors 1.6 W/m^{2}K domestic, 1.5 W/m^{2}K commercial, whole frame u-value
- Thermal bridging to be addressed with Accredited Construction Details applied throughout domestic units.
- Air permeability of 4.0 m^3/m^2.h @50Pa has been specified to be achieved on testing for each dwelling and commercial unit.

Domestic Heating and Hot Water:

- Gas boiler with efficiency of 90% with time and temperature zone control and delayed start thermostat in each dwelling.
- Flue Gas Heat Recovery Units (Ravenheat EnergyCatcher or similar).
- Waste Water Heat Recovery Units (Shower-save Recoh-vert RV3 or similar).

Commercial Heating and Hot Water:

- Heating and cooling via an air source heat pump with a heating COP of 4.0 and cooling ESEER of 4.5.
- Distribution efficiency for the heating system and cooling systems assumed to be as 90%.
- Variable speed pumping is assumed, with multiple differential pressure sensors in the system.
- Heat metering with alarms warning of out-of-range values not included.
- Hot water assumed to be point of use instantaneous electric water heating, without storage volumes
- Generation and distribution efficiency assumed to be 100%.

Renewable Energy Generation:

- Photovoltaic solar panel system of c.a. 0.7kWp per domestic plot and c.a. 1.25kWp to serve the commercial premises facing south east and south west at 15° will be required to meet the London Plan target.

Lighting:

- 100% low energy light fittings for domestic units
- Commercial spaces are to have photocell sensors throughout, with lighting dimmed automatically depending on levels of natural light in the space at any given time.
- Assumed design illuminance of 400lux to commercial areas.
- No time clock controls assumed to photocells. Parasitic power assumed as default 0.3 W/m2.
- Light metering with alarms warning of out-of-range values not included.

5.6 *Energy Efficiency Results*

5.6.1 By recording the baseline emissions for the development we are able to assess the effects of improvements detailed above on the 74 Church Road development. These are shown in the appendices in the conclusions of this report, and amount to a total reduction in carbon emissions of 35.88%.

6. Technology Consideration

6.1.1 As part of this process, a number of technologies have been considered, with feasibility / viability and practicality considered given the various design considerations.

6.1.2 A feasibility study has been undertaken, identifying the following:

- Appropriate technologies
- Energy generated from Low and Zero Carbon Technologies per annum
- Available funding grants
- Life cycle cost of specification (including allowances for payback)
- Local planning criteria (Inc. preferred solutions)
- Feasibility of exporting heat / electricity from chosen system

6.1.3 In order to fully identify appropriate technologies, an initial evaluation has been undertaken based on the expected baseline carbon emissions. Baseline emissions are calculated on a development with identical geometry built to meet Building Regulations, thus using standard building fabric parameters and notional heating systems.

6.2 *Photovoltaics*

6.2.1 The PV panels should be orientated between southeast and southwest (optimally south). The optimal tilt angle (inclination of panel from horizontal) should be calculated to ensure the best possible output of the system during the year. In the UK, the angles of most pitched roofs are suitable for mounting PV panels.

6.2.2 Panels can also be mounted on A-frames on flat-roofed buildings. PV technology comes in a range of forms: PV panels that can be retrofitted to the roof of an existing building or equally, sunk to fit flush with the roof line; PV cells that are 'laminated' between sheets of glass to provide shading in a glazed area, and PV cladding.

6.2.3 PV systems are low maintenance as they have no moving parts and panels generally have 25 year warranties, although the lifetime of the panel can be expected to be beyond this time.

Technical Considerations

6.2.4 The PV systems should not be shaded. Shading caused by other buildings, greenery and roof 'furniture' such as chimneys or satellite dishes, even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid. Although the Feed-in Tariffs are generally not high, exporters can negotiate with their utility company. Future consideration may be given to the benefits of battery storage.

Economic Considerations

6.2.5 Payback times for this technology are usually approximately twenty years; but this is reducing year on year as the technology matures and are set to reduce further as fuel prices increase. Integrating PV into a building and replacing other building materials can further offset the cost.

Suitability at the 74 Church Road Development

6.2.6 PV has been identified as a suitable technology for incorporation at 74 Church Road allowing the required 35% reduction in carbon emissions to be met. Photovoltaic solar panel system of c.a. 0.7kWp per domestic plot and c.a. 1.25kWp to serve the commercial premises facing south east and south west at 15° will be required to meet the London Plan target.

6.3 *Solar Water Heating*

6.3.1 A solar collector comprises the housing that contains piping, through which the carrier fluid circulates, and a glass panel to retain the radiation from the Sun. The temperature inside the collector increases and this heat is then transferred to a carrier fluid. In an open loop system, the hot water is heated directly.

6.3.2 Solar thermal panels are generally black in appearance for maximising energy absorption and the glass panels have a special coating in order to retain as much heat as possible.

6.3.3 Two types of collector exist: flat plate and evacuated tube. Flat plate collectors can be mounted on or flush with the roof. The air in the collection tubes can be evacuated to reduce heat losses within the frame by convection. Evacuated tube collectors need to be re-evacuated every few years. They are more difficult to install but are more efficient and allow higher temperature heating.

Benefits

6.3.4 Solar thermal collectors offer a good price-performance ratio. Solar hot water systems are best suited to developments with high hot water requirements, such as hotels, care homes and leisure centres. Many systems have been installed in the UK and they work well, even without direct sunlight.

Technical Considerations

6.3.5 Solar thermal systems should be sized to the hot water requirements of the user since any excess heat that is generated cannot be exported elsewhere. The optimal angle for mounting depends on when the water demand is greatest. Ideally, the collectors should be mounted onto a non-shaded, south-facing roof.

Economic Considerations

6.3.6 Solar thermal technology is a cost effective way to reduce carbon emissions, especially if it is replacing electric water heating.

Suitability at the 74 Church Road Development

6.3.7 Due to limited roof space at 74 Church Road, solar hot water cannot be used effectively alongside photovoltaic arrays. Accordingly it is considered preferable to install photovoltaic arrays over solar hot water where only one technology can be favoured.

6.4 *Air Source Heat Pumps*

6.4.1 Air source heat pumps work by converting the energy of the outside air into heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system. As with all heat pumps, air source models are most efficient when supplying low temperature systems such as underfloor heating.

6.4.2 An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C. Cold water or another fluid is circulated through pipes, picking up the ambient temperature and then passing through the heat exchanger (the evaporator) in the heat pump unit.

6.4.3 The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (+55°C). This heat is then transferred to the heating system via another heat exchanger, the condenser of the heat pump.

6.4.4 Accordingly ASHP heating systems generally run at a lower temperature than conventional heating systems. There are two main types of air source heat pumps. An air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are better suited to underfloor heating systems than radiator systems.

6.4.5 An air-to-air system produces warm air, which is circulated by fans to heat the building. Whilst heat pumps are not a wholly renewable energy source due to use of electricity, the renewable component is considered as the heat is extracted from the air. It is measured as the difference between heat outputs, less the primary electrical energy input. Using this heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This ‘Coefficient of Performance’ (CoP) of 4 is effectively an ‘efficiency’ of 400% for the system and compares very favourably with even the best gas condensing boiler’s efficiency of around 85%. The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump’s CoP.

Benefits

6.4.6 Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets ‘cleaner’, with more renewable electricity generation being brought on line, so the carbon emissions from the heat pumps system will decrease even further.

6.4.7 The key operational benefit of air source heat pumps for the user is the reduction in fuel bills. In addition, space savings can be made over other plant types as an air source heat pump unit is compact, and requires no storage space for fuel.

Technical Considerations

6.4.8 Since air source heat pumps produce less heat than traditional boilers, it is essential that the building where the air source heat pump is proposed is well insulated and draught proofed for the heating system to be effective. Fans and compressors integral to the air source heat pump unit generate some noise, but this is generally acceptable especially where outdoor units can be located away from windows and adjacent buildings. By selecting a heat pump with an outdoor sound rating of 7.6 dB or lower and mounting the unit on a noise-absorbing base these issues can be resolved for the site.

Economic Considerations

6.4.9 Costs for installing a typical system vary but they are considerably more economical to install than an equivalent capacity ground source heat system and can produce similar levels of energy and carbon savings. Actual running costs and savings for space heating will vary depending on a number of factors - including the size and use pattern of the building and how well insulated it is.

Suitability at the 74 Church Road Development

6.4.10 Due to outdoor space constraints and noise considerations, it is preferred to opt for photovoltaic panels with high efficiency mains gas boilers for the proposed development at 74 Church Road.

6.5 *Biomass Heating*

6.5.1 Biomass can be burnt directly to provide heat in buildings using wood from forests, urban tree pruning, and farmed coppices or as liquid biofuel, such as bio diesel. In non-domestic applications, biomass boilers replace conventional fossil fuel boilers and come with automated features to enable reduced user intervention.

6.5.2 With the long term availability of fossil fuels such as oil and gas, and the persistent number of price rises of oil and natural gas a growing concern in the UK, alternative heating methods such as wood burning boilers are becoming more popular.

6.5.3 Due to technical advances in wood burning technology, and improvements in the preparation of wood fuels, efficiencies of new wood pellet burning boilers have increased to around 90%, with carbon monoxide emissions dropping dramatically.

6.5.4 There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from sawmills, tree surgery and wind damage.

6.5.5 Wood chips have a high moisture content which tends to restrict their efficiency to only 50% and they tend to suffer from blockages hence we would be cautious about their use on this site. Storage space requirements are also high due to the irregularity of the chips. Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Technical and Economic Considerations

6.5.6 Biomass combustion systems (BCS) are generally more mechanically complex than conventional boiler heating systems, especially when it comes to fuel delivery, storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass as compared to conventional fossil fuels. The increased complexity means higher capital costs than for conventional systems. BCSs typically require more frequent maintenance and greater operator attention than conventional systems. As a result, the degree of operator dedication to the system is critical to its success. They often require special attention to fire insurance premiums, air quality standards, ash disposal options and general safety issues.

Suitability at the 74 Church Road Development

6.5.7 Due to the size of the proposed project, biomass energy has not been considered as an economically suitable technology for this development.

7. Other Sustainability Considerations

7.1 *The Code for Sustainable Homes*

7.1.1 Following the technical housing standards review, the government has withdrawn the Code for Sustainable Homes, and the scheme is no longer open to new registrations.

7.1.2 Anne Machin Architects values the sustainability credentials of the 74 Church Road development and has committed to the following measures alongside the carbon reduction strategies listed above.

7.2 *BREEAM*

7.2.1 A BREEAM pre-assessment has been undertaken to demonstrate how the commercial units will achieve the required BREEAM rating post construction. This can be viewed in the appendicies of this report.

7.3 *Internal Potable Water Consumption*

7.3.1 It is the aim of Anne Machin Architects to reduce the consumption of potable water in the 74 Church Road development from all sources, through the use of efficient fittings and flow restrictors where required.

7.3.2 Performance in domestic properties will be assessed under the methodologies set out in Part G of the Building Regulations, once a full design stage sanitary specification has been established.

7.3.3 The design will be such that potable water consumption meets a target of 105L per head per day or less for each dwelling at 74 Church Road.

7.3.4 This is equivalent to the consumption targets set under the now obsolete Code for Sustainable Homes Level 4.

7.4 *Overheating Considerations*

7.4.1 An overheating assessment has been carried out as a part of the process to produce SAP calculations. This assessment is related to the factors that contribute to internal temperature: solar gain (taking account of orientation, shading and glazing transmission), ventilation (taking account of window opening in hot weather), thermal capacity and mean summer temperature for the location of the dwelling. Full details of this methodology and relevant calculations can be found in the latest approved SAP document.

7.4.2 Using these criteria the proposed development at 74 Church Road has been found to be compliant with overheating rules within SAP.

7.5 *Sourcing of Materials & Waste Reduction*

7.5.1 Materials will be chosen to lower the environmental impact of the development at 74 Church Road wherever possible.

7.5.2 All timber used during the development will come from a ‘legal source’ and will not be on the CITES list, or in the case of Appendix III of the CITES list, it will not have been sourced from a country seeking to protect this species as listed in Appendix III.

8. Conclusion

8.1.1 This strategy is based on the Energy Hierarchy, as follows:

- Use less energy (Be lean)
- Supply energy efficiently (Be clean)
- Use renewable energy (Be green)

8.1.2 These measures result in a reduction in CO_2 emissions of 35.88% when measured against Part L 2013 Building Regulations.

8.1.3 The following charts details the reductions in CO_2 emissions as a result of following the energy hierarchy.

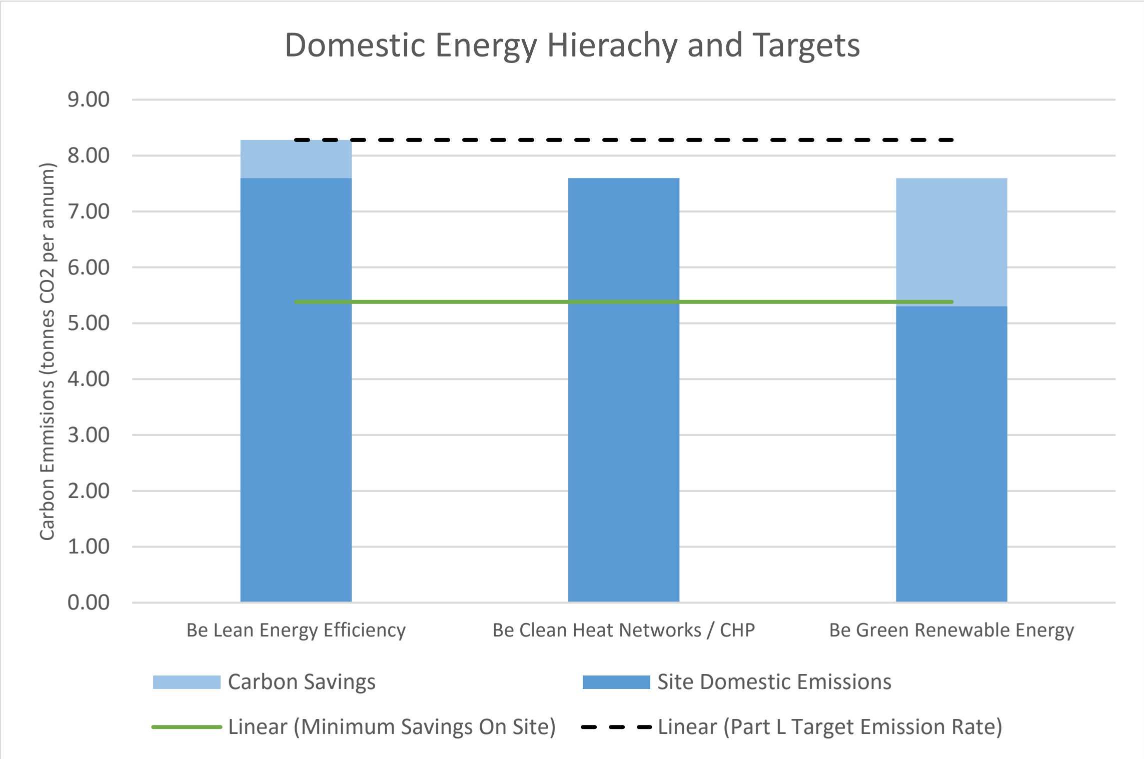


Figure 2 –Domestic Carbon Emissions at 74 Church Road at Each Stage of the Energy Hierarchy.

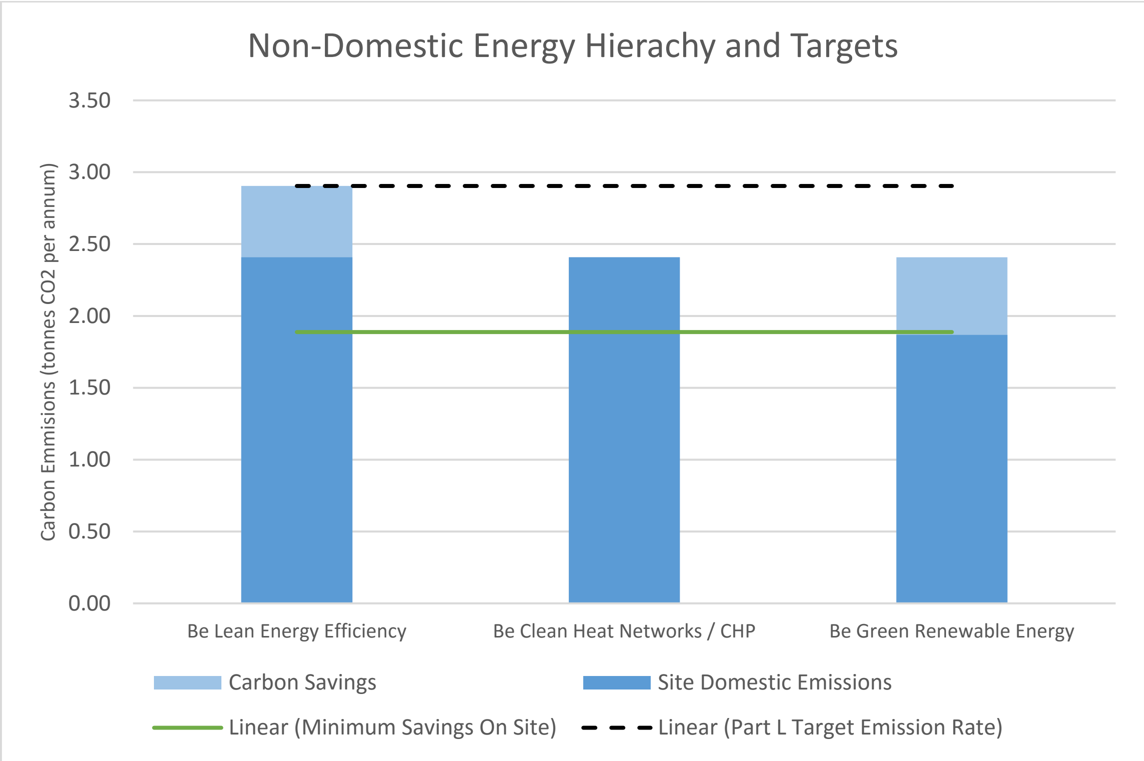


Figure 3 –Non-Domestic Carbon Emissions at 74 Church Road at Each Stage of the Energy Hierarchy.

9. Appendices

9.1 *Appendix A - Domestic Results*

9.2 *Appendix B - SAP Documents*

9.3 *Appendix C - Non- Domestic Results Tables*

9.4 *Appendix D - SBEM/BRUKL Reporting*

9.5 *Appendix E - SBEM Input Parameters*

9.6 *Appendix F - Site Wide Results Tables*

9.7 *Appendix G - Possible PV Locations*

9.8 *Appendix H – BREEAM Pre Assessment*

Appendix A - Domestic Results Tables

Cumulative Emissions & Savings

The following tables are presented in accordance with the advice presented within 'Energy Planning - Greater London Authority guidance on preparing energy assessments'.

	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	8.28	2.98
After energy demand reduction	7.60	2.98
After heat network / CHP	7.60	2.98
After renewable energy	5.30	2.98

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings.

	Regulated Carbon dioxide savings	
	(Tonnes CO_2 / annum)	**(%)**
Savings from energy demand reduction	0.68	8.25
Savings from heat network / CHP	0.00	0.00
Savings from renewable energy	2.29	27.70
Cumulative on site Savings	**2.98**	**35.96**
Total Target Savings	2.90	35.00
Annual Surplus	0.08	

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings.

Results by Plot

Baseline

Baseline: Part L 2013 of the Building Regulations Compliant Development	**Domestic Total (Sum)**	Ground Floor	First Floor
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**8.279**	2.952	5.328

Be Lean

After energy demand reduction	**Domestic Total (Sum)**	Ground Floor	First Floor
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**8.279**	2.952	5.328
Be Lean	**7.596**	2.645	4.951
% Improvement	**8.25**	10.38	7.08

Be Lean & Clean

After heat network / CHP	**Domestic Total (Sum)**	Ground Floor	First Floor
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**8.279**	2.952	5.328
Be Lean & Clean	**7.596**	2.645	4.951
% Improvement	**8.25**	10.38	7.08

Be Lean, Clean & Green

After renewable energy	**Domestic Total (Sum)**	Ground Floor	First Floor
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**8.279**	2.952	5.328
Be Lean, Clean & Green	**5.302**	1.942	3.360
% Improvement	**35.96**	34.21	36.92

Unregulated Emissions

Emissions from Sources not Regulated under Part L of the Building Regulations (Tonnes CO2 / annum)	**Domestic Total (Sum)**	Ground Floor	First Floor
	2.98	1.44	1.54

Appendix B

SAP WorkSheet: New dwelling design stage

build energy | compliance testing consulting

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Baseline First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	44.07	(1a)	x	3.03	(2a)	=	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.59999990463257	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.45	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 2			2.13	x1/[1/(1.4)+ 0.04]		=	2.82			(27)
Windows Type 3			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Windows Type 4			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Rooflights Type 1			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 2			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 3			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 4			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.57 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 36.21 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	26.48	26.31	26.14	25.34	25.19	24.5	24.5	24.37	24.77	25.19	25.5	25.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.69	62.52	62.35	61.55	61.4	60.71	60.71	60.58	60.98	61.4	61.7	62.02	

Average = Sum(39)$_{1...12}$ /12= | 61.55 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.42	1.42	1.41	1.4	1.39	1.38	1.38	1.37	1.38	1.39	1.4	1.41

Average = Sum(40)$_{1...12}$ /12= | 1.4 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.52 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 70.26 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28	
										Total = Sum(44)$_{1...12}$ =		843.09	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99	
										Total = Sum(45)$_{1...12}$ =		1105.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	126.68	110.5	115.43	103.91	101.38	90.32	88.23	97.1	97.9	109.92	115.55	123.99	

Output from water heater (annual)$_{1…12}$ — 1280.91 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	(66)

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

(67)m=	29.39	26.1	21.23	16.07	12.01	10.14	10.96	14.25	19.12	24.28	28.34	30.21	(67)

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

(68)m=	196.85	198.89	193.74	182.78	168.95	155.95	147.27	145.22	150.37	161.33	175.16	188.16	(68)

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

(69)m=	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)

Water heating gains (Table 5)

(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.68	373.33	359.46	338.28	316.94	297.39	285.97	292.25	304.38	325.71	349.44	367.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	456.46	518.74	581.83	650.03	696.98	687.69	656.89	610.61	557.65	492.91	446.78	434.3	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.86	0.72	0.54	0.4	0.45	0.68	0.9	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.79	19.98	20.27	20.62	20.86	20.97	20.99	20.99	20.92	20.6	20.14	19.75	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.75	19.75	19.75	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.76	19.76	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.92	0.82	0.65	0.45	0.29	0.33	0.59	0.86	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.47	18.89	19.37	19.65	19.76	19.78	19.78	19.72	19.36	18.71	18.15	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.06	19.29	19.64	20.05	20.31	20.42	20.44	20.43	20.37	20.03	19.48	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

SAP WorkSheet: New dwelling design stage

(93)m=	18.91	19.14	19.49	19.9	20.16	20.27	20.29	20.28	20.22	19.88	19.33	18.87	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.96	0.92	0.83	0.68	0.49	0.34	0.38	0.63	0.87	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	444.31	495.74	533.48	538.17	472.43	335.41	222.43	233.06	348.81	426.82	426.46	424.59	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	915.6	890	809.77	676.91	519.33	344.01	223.78	235.33	373.22	569.84	754.73	909.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	350.64	264.94	205.56	99.89	34.89	0	0	0	0	106.41	236.35	360.89	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1659.58 (98)

Space heating requirement in kWh/m²/year 37.66 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	350.64	264.94	205.56	99.89	34.89	0	0	0	0	106.41	236.35	360.89	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	385.75	291.46	226.14	109.89	38.39	0	0	0	0	117.06	260.02	397.02	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1825.73 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	126.68	110.5	115.43	103.91	101.38	90.32	88.23	97.1	97.9	109.92	115.55	123.99	
Efficiency of water heater												80.8	(216)
(217)m=	87.98	87.67	86.99	85.45	83.17	80.8	80.8	80.8	80.8	85.47	87.32	88.08	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	143.99	126.03	132.7	121.59	121.9	111.78	109.2	120.18	121.17	128.6	132.33	140.76	

Total = Sum(219a)$_{1...12}$ = 1510.23 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1825.73

SAP WorkSheet: New dwelling design stage

Water heating fuel used			1510.23	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			207.61	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	63.54	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	52.56	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	27.38	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			285.24	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.35	(257)
SAP rating (Section 12)		81.24	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	394.36	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	326.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			720.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	107.75	(268)
Total CO2, kg/year		sum of (265)…(271) =		913.95	(272)
CO2 emissions per m²		(272) ÷ (4) =		20.74	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

SAP WorkSheet: New dwelling design stage

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2227.39	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1842.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4069.86	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	506.55	(267)
Electricity for lighting	(232)	x	0	=	637.37	(268)
'Total Primary Energy			sum of (265)…(271) =		5213.78	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		118.31	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Baseline First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	44.07	(1a)	x	3.03	(2a)	=	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.59999990463257	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.45	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 2			2.13	x1/[1/(1.4)+ 0.04]		=	2.82			(27)
Windows Type 3			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Windows Type 4			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Rooflights Type 1			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 2			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 3			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 4			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.57 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 36.21 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	26.48	26.31	26.14	25.34	25.19	24.5	24.5	24.37	24.77	25.19	25.5	25.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.69	62.52	62.35	61.55	61.4	60.71	60.71	60.58	60.98	61.4	61.7	62.02	

Average = Sum(39)$_{1...12}$ /12= | 61.55 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.42	1.42	1.41	1.4	1.39	1.38	1.38	1.37	1.38	1.39	1.4	1.41	

Average = Sum(40)$_{1...12}$ /12= | 1.4 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.52 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 70.26 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28	

Total = Sum(44)$_{1...12}$ = | 843.09 | (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99	

Total = Sum(45)$_{1...12}$ = | 1105.43 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	126.68	110.5	115.43	103.91	101.38	90.32	88.23	97.1	97.9	109.92	115.55	123.99	

Output from water heater (annual)$_{1...12}$ 1280.91 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	(66)

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

(67)m=	11.76	10.44	8.49	6.43	4.81	4.06	4.38	5.7	7.65	9.71	11.33	12.08	(67)

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

(68)m=	131.89	133.26	129.81	122.47	113.2	104.49	98.67	97.3	100.75	108.09	117.36	126.07	(68)

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

(69)m=	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)

Water heating gains (Table 5)

(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.87	261.82	252.57	238.1	223.76	209.63	200.57	205.56	213.06	227.69	244.42	256.76	(73)

DER WorkSheet: New dwelling design stage

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.65	407.23	474.94	549.84	603.8	599.92	571.49	523.92	466.33	394.89	341.76	323.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.79	0.61	0.46	0.52	0.77	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.57	19.77	20.1	20.5	20.81	20.95	20.99	20.98	20.87	20.46	19.94	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.75	19.75	19.75	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.76	19.76	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.88	0.72	0.51	0.34	0.39	0.68	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.88	18.18	18.65	19.22	19.59	19.75	19.78	19.78	19.68	19.18	18.43	17.84	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	19.04	19.43	19.91	20.25	20.4	20.43	20.43	20.33	19.87	19.25	18.76	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.64	18.89	19.28	19.76	20.1	20.25	20.28	20.28	20.18	19.72	19.1	18.61		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.95	0.88	0.74	0.55	0.39	0.44	0.71	0.92	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	340.08	398.72	452.44	484.86	448.78	329.63	221.32	231.05	330.96	364.44	335.06	321.2		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	899.2	874.64	796.89	668.64	515.83	343.17	223.6	235.01	370.59	560.09	740.41	893.55		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	415.98	319.82	256.27	132.32	49.88	0	0	0	0	145.57	291.86	425.83		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2037.51	(98)
Space heating requirement in kWh/m²/year													46.23	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	415.98	319.82	256.27	132.32	49.88	0	0	0	0	145.57	291.86	425.83		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	457.62	351.84	281.92	145.56	54.87	0	0	0	0	160.14	321.07	468.46		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2241.49	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	126.68	110.5	115.43	103.91	101.38	90.32	88.23	97.1	97.9	109.92	115.55	123.99		
Efficiency of water heater													80.8	(216)
(217)m=	88.32	88.07	87.5	86.16	83.87	80.8	80.8	80.8	80.8	86.26	87.79	88.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	143.43	125.46	131.92	120.59	120.87	111.78	109.2	120.18	121.17	127.43	131.62	140.25		
Total = Sum(219a)$_{1...12}$ =													1503.89	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2241.49

DER WorkSheet: New dwelling design stage

Water heating fuel used		1503.89	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	120		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	165	(231)
Electricity for lighting		207.61	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	484.16	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	324.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				809	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	85.64	(267)
Electricity for lighting	(232)	x	0.519	=	107.75	(268)
Total CO2, kg/year			sum of (265)…(271) =		1002.39	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		22.75	(273)
EI rating (section 14)					85	(274)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Baseline Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	70.43	(1a)	x	2.42	(2a)	=	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		7.59999990463257	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.56	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.55	0.54	0.53	0.47	0.46	0.41	0.41	0.4	0.43	0.46	0.48	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	36.61	36.28	35.96	34.44	34.16	32.84	32.84	32.59	33.34	34.16	34.73	35.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.14	75.81	75.49	73.97	73.68	72.36	72.36	72.12	72.87	73.68	74.26	74.86	

Average = Sum(39)$_{1…12}$ /12= 73.97 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.08	1.08	1.07	1.05	1.05	1.03	1.03	1.02	1.03	1.05	1.05	1.06

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57

Total = Sum(44)$_{1...12}$ = 1053.51 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69

Total = Sum(45)$_{1...12}$ = 1381.32 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0

(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	154.77	134.96	141.07	127.28	124.32	110.93	108.65	119.39	120.32	134.82	141.41	151.52	

Output from water heater (annual)$_{1\ldots12}$ 1569.43 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.68	40.57	32.99	24.98	18.67	15.76	17.03	22.14	29.72	37.73	44.04	46.94	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	295.97	299.04	291.3	274.82	254.03	234.48	221.42	218.35	226.09	242.56	263.36	282.91	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)
Water heating gains (Table 5)													
(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	528.11	523.44	503.32	472.5	441.07	412.78	396.55	404.88	422.82	453.84	488.24	514.3	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)
North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)

North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	586.94	637.82	693.25	756.99	799.62	784.96	748.71	700.2	645.71	589.68	561.39	562.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.91	0.77	0.58	0.42	0.47	0.72	0.93	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.2	20.43	20.72	20.91	20.99	21	21	20.95	20.71	20.35	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.02	20.02	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.88	0.72	0.5	0.33	0.38	0.64	0.91	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.8	18.99	19.31	19.72	19.96	20.05	20.06	20.06	20.02	19.72	19.22	18.79	(90)

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.32	19.49	19.77	20.14	20.35	20.44	20.45	20.45	20.41	20.13	19.69	19.31	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.17	19.34	19.62	19.99	20.2	20.29	20.3	20.3	20.26	19.98	19.54	19.16		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.98	0.98	0.95	0.88	0.73	0.52	0.36	0.4	0.66	0.9	0.97	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	578.02	622.11	658.45	662.82	580.99	405.98	267.07	280.14	428.04	532.47	545.7	555.74		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1132.51	1094.73	990.73	819.95	626.65	411.67	267.67	281.23	448.64	691.16	923.54	1120		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	412.55	317.6	247.21	113.13	33.97	0	0	0	0	118.07	272.05	419.81		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													1934.38	(98)
Space heating requirement in kWh/m²/year													27.47	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	412.55	317.6	247.21	113.13	33.97	0	0	0	0	118.07	272.05	419.81		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	453.84	349.39	271.96	124.46	37.37	0	0	0	0	129.89	299.28	461.84		
Total (kWh/year) =Sum(211)1...5,10...12=													2128.03	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)
Water heating														
Output from water heater (calculated above)														
	154.77	134.96	141.07	127.28	124.32	110.93	108.65	119.39	120.32	134.82	141.41	151.52		
Efficiency of water heater													80.8	(216)
(217)m=	87.9	87.63	86.95	85.26	82.77	80.8	80.8	80.8	80.8	85.22	87.17	87.98		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	176.07	154.01	162.24	149.28	150.19	137.29	134.47	147.76	148.91	158.2	162.22	172.21		
Total = Sum(219a)1...12 =													1852.85	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2128.03

SAP WorkSheet: New dwelling design stage

Water heating fuel used			1852.85	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			322.66	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	74.06	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	64.48	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.56	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	322.86	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.17	(257)
SAP rating (Section 12)		83.61	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	459.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	400.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			859.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	167.46	(268)
Total CO2, kg/year		sum of (265)…(271) =		1112.97	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.8	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

SAP WorkSheet: New dwelling design stage

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2596.2	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2260.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4856.68	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	506.55	(267)
Electricity for lighting	(232)	x	0	=	990.56	(268)
'Total Primary Energy			sum of (265)…(271) =		6353.79	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		90.21	(273)

DER WorkSheet: New dwelling design stage

compliance testing consulting

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Baseline Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.43	(1a) x	2.42	(2a) =	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		7.59999990463257	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.56	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.43	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.55	0.54	0.53	0.47	0.46	0.41	0.41	0.4	0.43	0.46	0.48	0.51

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.65	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	36.61	36.28	35.96	34.44	34.16	32.84	32.84	32.59	33.34	34.16	34.73	35.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	76.14	75.81	75.49	73.97	73.68	72.36	72.36	72.12	72.87	73.68	74.26	74.86	

Average = Sum(39)$_{1…12}$ /12= 73.97 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.08	1.08	1.07	1.05	1.05	1.03	1.03	1.02	1.03	1.05	1.05	1.06	

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57	

Total = Sum(44)$_{1...12}$ = 1053.51 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69	

Total = Sum(45)$_{1...12}$ = 1381.32 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	154.77	134.96	141.07	127.28	124.32	110.93	108.65	119.39	120.32	134.82	141.41	151.52	

Output from water heater (annual)$_{1...12}$ 1569.43 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.27	16.23	13.2	9.99	7.47	6.31	6.81	8.86	11.89	15.09	17.61	18.78	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	198.3	200.36	195.17	184.13	170.2	157.1	148.35	146.29	151.48	162.52	176.45	189.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)
Water heating gains (Table 5)													
(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	363.96	361.34	348.31	327.74	306.97	286.87	274.18	280.47	291.31	312.08	335.83	353.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)
North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)

North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	422.79	475.72	538.24	612.23	665.51	659.05	626.35	575.78	514.2	447.92	408.98	402.25	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.86	0.67	0.5	0.56	0.84	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	19.99	20.24	20.58	20.84	20.97	20.99	20.99	20.9	20.55	20.15	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.02	20.02	20.04	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.81	0.58	0.4	0.46	0.77	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.69	19.05	19.55	19.89	20.04	20.06	20.06	19.97	19.52	18.94	18.48	(90)

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.05	19.23	19.54	19.97	20.29	20.43	20.45	20.45	20.36	19.95	19.44	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.9	19.08	19.39	19.82	20.14	20.28	20.3	20.3	20.21	19.8	19.29	18.89		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	0.99	0.98	0.94	0.81	0.61	0.42	0.48	0.78	0.96	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	421.2	472.18	527.7	572.44	541.88	398.75	266.11	278.2	400.43	430.66	405.87	401.08		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1111.76	1074.85	973.3	808.1	621.7	410.77	267.53	280.97	445.16	677.82	905.29	1099.84		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	513.78	404.99	331.53	169.67	59.38	0	0	0	0	183.89	359.59	519.88		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				2542.71	(98)
Space heating requirement in kWh/m²/year													36.1	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	513.78	404.99	331.53	169.67	59.38	0	0	0	0	183.89	359.59	519.88		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	565.21	445.54	364.72	186.66	65.33	0	0	0	0	202.29	395.59	571.92		
									Total (kWh/year) =Sum(211)$_{1...5,10....12}$=				2797.26	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10....12}$=				0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	154.77	134.96	141.07	127.28	124.32	110.93	108.65	119.39	120.32	134.82	141.41	151.52		
Efficiency of water heater													80.8	(216)
(217)m=	88.34	88.15	87.63	86.28	83.81	80.8	80.8	80.8	80.8	86.33	87.8	88.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	175.19	153.11	160.99	147.52	148.33	137.29	134.47	147.76	148.91	156.16	161.06	171.39		
									Total = Sum(219a)$_{1...12}$ =				1842.17	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2797.26

Water heating fuel used		1842.17	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	120		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	165	(231)
Electricity for lighting		322.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	604.21	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	397.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1002.12	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	85.64	(267)
Electricity for lighting	(232)	x	0.519	=	167.46	(268)
Total CO2, kg/year			sum of (265)…(271) =		1255.21	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.82	(273)
EI rating (section 14)					85	(274)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Green First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	44.07	(1a)	x	3.03	(2a)	=	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 2			2.13	x1/[1/(1.4)+ 0.04]		=	2.82			(27)
Windows Type 3			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Windows Type 4			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Rooflights Type 1			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 2			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 3			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 4			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 11.57 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 36.21 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.91	25.76	25.61	24.92	24.79	24.19	24.19	24.07	24.42	24.79	25.05	25.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.12	61.97	61.82	61.13	61	60.4	60.4	60.28	60.63	61	61.26	61.54	

Average = Sum(39)$_{1...12}$ /12= 61.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.41	1.4	1.39	1.38	1.37	1.37	1.37	1.38	1.38	1.39	1.4	

Average = Sum(40)$_{1...12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.52 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 70.26 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28	

Total = Sum(44)$_{1...12}$ = 843.09 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99	

Total = Sum(45)$_{1...12}$ = 1105.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	31.28	26.91	26.75	16.41	11.49	7.99	7.57	8.58	8.64	17.72	27.31	30.99	(63) (G2)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	93.51	81.94	86.93	85.87	88.27	80.83	79.11	86.91	87.63	90.45	86.47	91.11

Output from water heater (annual)$_{1...12}$ — 1039.04 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	29.39	26.1	21.23	16.07	12.01	10.14	10.96	14.25	19.12	24.28	28.34	30.21	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	196.85	198.89	193.74	182.78	168.95	155.95	147.27	145.22	150.37	161.33	175.16	188.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)
Water heating gains (Table 5)													
(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	376.68	373.33	359.46	338.28	316.94	297.39	285.97	292.25	304.38	325.71	349.44	367.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	456.46	518.74	581.83	650.03	696.98	687.69	656.89	610.61	557.65	492.91	446.78	434.3	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.86	0.72	0.54	0.4	0.45	0.68	0.9	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.8	19.99	20.29	20.63	20.87	20.97	20.99	20.99	20.92	20.61	20.15	19.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.92	0.82	0.65	0.45	0.29	0.33	0.59	0.86	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.5	18.91	19.38	19.66	19.77	19.78	19.78	19.73	19.37	18.73	18.18	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.31	19.66	20.06	20.31	20.42	20.44	20.44	20.38	20.04	19.5	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	18.93	19.16	19.51	19.91	20.16	20.27	20.29	20.29	20.23	19.89	19.35	18.89	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.96	0.92	0.83	0.68	0.49	0.34	0.38	0.62	0.86	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	444.25	495.58	533.04	537.22	470.83	334.11	221.49	232.14	347.65	426.31	426.34	424.56	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	908.74	883.56	804.11	672.97	516.34	342.42	222.79	234.32	371.36	566.73	750.26	903.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	345.58	260.72	201.67	97.73	33.85	0	0	0	0	104.47	233.23	356.55	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1633.8 (98)

Space heating requirement in kWh/m²/year 37.07 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	345.58	260.72	201.67	97.73	33.85	0	0	0	0	104.47	233.23	356.55	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	380.17	286.82	221.86	107.52	37.24	0	0	0	0	114.93	256.57	392.24	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 1797.37 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	93.51	81.94	86.93	85.87	88.27	80.83	79.11	86.91	87.63	90.45	86.47	91.11	
Efficiency of water heater												80.8	(216)
(217)m=	88.54	88.26	87.6	85.88	83.37	80.8	80.8	80.8	80.8	85.92	87.93	88.64	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	105.61	92.84	99.24	99.99	105.89	100.03	97.91	107.56	108.45	105.27	98.35	102.78	

Total = $Sum(219a)_{1...12}$ = 1223.93 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1797.37

Water heating fuel used			1223.93	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			207.61	(232)
Electricity generated by PVs			-576.34	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	62.55	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	42.59	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	27.38	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			274.29	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		81.96	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	388.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	264.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =			652.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	107.75	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-299.12	(269)

Total CO2, kg/year	sum of (265)…(271) =	546.86	(272)
CO2 emissions per m²	(272) ÷ (4) =	12.41	(273)
EI rating (section 14)		92	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2192.79	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1493.19	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3685.98	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	506.55	(267)
Electricity for lighting	(232)	x	0	=	637.37	(268)
Energy saving/generation technologies Item 1			3.07	=	-1769.38	(269)
'Total Primary Energy	sum of (265)…(271) =				3060.51	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =				69.45	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Green First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	44.07	(1a) x	3.03	(2a) =	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 2			2.13	x1/[1/(1.4)+ 0.04]		=	2.82			(27)
Windows Type 3			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Windows Type 4			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Rooflights Type 1			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 2			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 3			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 4			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.57 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 36.21 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.91	25.76	25.61	24.92	24.79	24.19	24.19	24.07	24.42	24.79	25.05	25.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.12	61.97	61.82	61.13	61	60.4	60.4	60.28	60.63	61	61.26	61.54	

Average = $Sum(39)_{1...12}$ /12= | 61.13 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.41	1.4	1.39	1.38	1.37	1.37	1.37	1.38	1.38	1.39	1.4

Average = $Sum(40)_{1...12}$ /12= | 1.39 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.52 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 70.26 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28	
										Total = $Sum(44)_{1...12}$ =		843.09	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99	
										Total = $Sum(45)_{1...12}$ =		1105.43	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	32.65	27.9	27.7	18.7	12.5	7.99	7.57	8.58	8.64	20.63	28.35	32.3	(63) (G2)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	92.15	80.95	85.98	83.58	87.26	80.83	79.11	86.91	87.63	87.53	85.43	89.8	

Output from water heater (annual)$_{1...12}$ — 1027.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	(66)

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

(67)m=	11.76	10.44	8.49	6.43	4.81	4.06	4.38	5.7	7.65	9.71	11.33	12.08	(67)

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

(68)m=	131.89	133.26	129.81	122.47	113.2	104.49	98.67	97.3	100.75	108.09	117.36	126.07	(68)

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

(69)m=	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)

Water heating gains (Table 5)

(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.87	261.82	252.57	238.1	223.76	209.63	200.57	205.56	213.06	227.69	244.42	256.76	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.65	407.23	474.94	549.84	603.8	599.92	571.49	523.92	466.33	394.89	341.76	323.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.79	0.61	0.46	0.51	0.77	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.79	20.11	20.51	20.81	20.95	20.99	20.98	20.88	20.47	19.95	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.88	0.72	0.51	0.33	0.39	0.67	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.21	18.67	19.23	19.61	19.76	19.78	19.78	19.69	19.19	18.45	17.87	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.82	19.06	19.45	19.93	20.26	20.41	20.44	20.43	20.33	19.88	19.26	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.67	18.91	19.3	19.78	20.11	20.26	20.29	20.28	20.18	19.73	19.11	18.63	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.74	0.55	0.39	0.44	0.71	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	340.09	398.69	452.29	484.34	447.6	328.47	220.41	230.19	330.12	364.24	335.04	321.2	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	892.45	868.32	791.36	664.81	512.91	341.6	222.61	234.02	368.79	557.08	736.04	887.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	410.96	315.59	252.27	129.94	48.59	0	0	0	0	143.47	288.72	421.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2011.08 (98)

Space heating requirement in kWh/m²/year 45.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	410.96	315.59	252.27	129.94	48.59	0	0	0	0	143.47	288.72	421.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	452.1	347.19	277.52	142.95	53.46	0	0	0	0	157.84	317.62	463.74	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2212.41 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	92.15	80.95	85.98	83.58	87.26	80.83	79.11	86.91	87.63	87.53	85.43	89.8	
Efficiency of water heater												80.8	(216)
(217)m=	88.87	88.64	88.1	86.66	84.14	80.8	80.8	80.8	80.8	86.79	88.38	88.95	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	103.69	91.32	97.59	96.44	103.7	100.03	97.91	107.56	108.45	100.86	96.67	100.96	

Total = Sum(219a)$_{1...12}$ = 1205.2 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2212.41

DER WorkSheet: New dwelling design stage

Water heating fuel used				1205.2	
Electricity for pumps, fans and electric keep-hot					
central heating pump:			120		(230c)
boiler with a fan-assisted flue			45		(230e)
Total electricity for the above, kWh/year		sum of (230a)…(230g) =		165	(231)
Electricity for lighting				207.61	(232)
Electricity generated by PVs				-576.34	(233)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	477.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	260.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			738.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	107.75	(268)
Energy saving/generation technologies Item 1		0.519	=	-299.12	(269)
Total CO2, kg/year		sum of (265)…(271) =		632.47	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.35	(273)
EI rating (section 14)				90	(274)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Green Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.43	(1a) x	2.42	(2a) =	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.01	31.85	31.71	31.01	30.88	30.28	30.28	30.17	30.51	30.88	31.15	31.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.53	71.38	71.23	70.54	70.41	69.8	69.8	69.69	70.04	70.41	70.67	70.95	

Average = Sum(39)$_{1…12}$ /12= 70.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1.01

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57	
										Total = Sum(44)$_{1…12}$ =		1053.51	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69	
										Total = Sum(45)$_{1…12}$ =		1381.32	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	35.11	30.78	29.8	19.28	13.28	9.73	9.24	10.45	10.53	20.47	30.52	34.86	(63) (G2)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	117.3	102.13	109.09	105.96	109.02	99.33	97.47	106.92	107.75	112.17	108.69	114.29	

Output from water heater (annual)$_{1...12}$ 1290.12 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	(66)

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

(67)m=	45.68	40.57	32.99	24.98	18.67	15.76	17.03	22.14	29.72	37.73	44.04	46.94	(67)

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

(68)m=	295.97	299.04	291.3	274.82	254.03	234.48	221.42	218.35	226.09	242.56	263.36	282.91	(68)

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

(69)m=	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)

Water heating gains (Table 5)

(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	528.11	523.44	503.32	472.5	441.07	412.78	396.55	404.88	422.82	453.84	488.24	514.3	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)

North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)
North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	586.94	637.82	693.25	756.99	799.62	784.96	748.71	700.2	645.71	589.68	561.39	562.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.45	0.71	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.29	20.5	20.76	20.93	20.99	21	21	20.96	20.74	20.41	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.87	0.7	0.48	0.33	0.37	0.63	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.97	19.15	19.46	19.81	20.02	20.08	20.09	20.09	20.06	19.8	19.34	18.94	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.47	19.62	19.89	20.21	20.4	20.46	20.47	20.47	20.43	20.19	19.78	19.43	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.32	19.47	19.74	20.06	20.25	20.31	20.32	20.32	20.28	20.04	19.63	19.28	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.86	0.71	0.5	0.35	0.39	0.65	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	577.5	620.95	655.22	654.78	566.32	394.31	259.06	272.2	417.13	527.88	544.67	555.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1074.09	1040.21	943.06	786.96	601.73	398.55	259.47	272.99	433.17	664.96	885.66	1070.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	369.46	281.74	214.15	95.17	26.34	0	0	0	0	101.98	245.51	382.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1717.24 (98)

Space heating requirement in kWh/m²/year 24.38 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	369.46	281.74	214.15	95.17	26.34	0	0	0	0	101.98	245.51	382.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	406.45	309.95	235.59	104.7	28.98	0	0	0	0	112.19	270.09	421.21	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1889.15 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	117.3	102.13	109.09	105.96	109.02	99.33	97.47	106.92	107.75	112.17	108.69	114.29

Efficiency of water heater 80.8 (216)

(217)m=	88.24	87.97	87.22	85.28	82.59	80.8	80.8	80.8	80.8	85.31	87.54	88.36	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	132.93	116.09	125.07	124.24	132.01	122.94	120.64	132.32	133.36	131.47	124.16	129.34

Total = Sum(219a)$_{1...12}$ = 1524.57 (219)

SAP WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1889.15	
Water heating fuel used			1524.57	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			322.66	(232)
Electricity generated by PVs			-576.34	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	65.74	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	53.06	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.56	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	303.12	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.1	(257)
SAP rating (Section 12)		84.61	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	408.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	329.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =			737.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	167.46	(268)

Energy saving/generation technologies					
Item 1		0.519	=	-299.12	(269)
Total CO2, kg/year		sum of (265)…(271) =		691.34	(272)
CO2 emissions per m²		(272) ÷ (4) =		9.82	(273)
EI rating (section 14)				92	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2304.77	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1859.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4164.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	506.55	(267)
Electricity for lighting	(232) x	0	=	990.56	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1769.38	(269)
‘Total Primary Energy		sum of (265)…(271) =		3892.47	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		55.27	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Green Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	70.43	(1a)	x	2.42	(2a)	=	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.01	31.85	31.71	31.01	30.88	30.28	30.28	30.17	30.51	30.88	31.15	31.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.53	71.38	71.23	70.54	70.41	69.8	69.8	69.69	70.04	70.41	70.67	70.95	

Average = Sum(39)$_{1…12}$ /12= 70.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1.01

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57

Total = Sum(44)$_{1…12}$ = 1053.51 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69

Total = Sum(45)$_{1…12}$ = 1381.32 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	37.61	32.69	31.68	23.69	15.09	9.73	9.24	10.45	10.53	25.73	32.5	37.28	(63) (G2)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	114.8	100.21	107.2	101.55	107.21	99.33	97.47	106.92	107.75	106.9	106.71	111.87	

Output from water heater (annual)$_{1...12}$ 1267.93 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	(66)

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

(67)m=	18.27	16.23	13.2	9.99	7.47	6.31	6.81	8.86	11.89	15.09	17.61	18.78	(67)

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

(68)m=	198.3	200.36	195.17	184.13	170.2	157.1	148.35	146.29	151.48	162.52	176.45	189.55	(68)

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

(69)m=	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)

Water heating gains (Table 5)

(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	363.96	361.34	348.31	327.74	306.97	286.87	274.18	280.47	291.31	312.08	335.83	353.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)

North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)
North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	422.79	475.72	538.24	612.23	665.51	659.05	626.35	575.78	514.2	447.92	408.98	402.25	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.84	0.65	0.49	0.55	0.82	0.97	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.08	20.31	20.63	20.87	20.98	21	20.99	20.92	20.59	20.21	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.39	0.44	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.66	18.85	19.2	19.65	19.96	20.08	20.09	20.09	20.02	19.61	19.06	18.62	(90)

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.19	19.36	19.66	20.05	20.34	20.45	20.47	20.46	20.39	20.02	19.54	19.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.04	19.21	19.51	19.9	20.19	20.3	20.32	20.31	20.24	19.87	19.39	19.01	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.8	0.59	0.41	0.47	0.76	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.21	472.09	527.03	569.24	532.4	388.51	258.35	270.71	393.36	429.52	405.8	401.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1054.42	1021.4	926.76	776.2	597.6	397.84	259.37	272.79	430.27	652.54	868.24	1050.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	471.11	369.14	297.39	149.01	48.51	0	0	0	0	165.93	332.96	483.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2317.4 (98)

Space heating requirement in kWh/m²/year 32.9 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	471.11	369.14	297.39	149.01	48.51	0	0	0	0	165.93	332.96	483.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	518.27	406.09	327.16	163.93	53.37	0	0	0	0	182.54	366.29	531.75	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2549.4 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	114.8	100.21	107.2	101.55	107.21	99.33	97.47	106.92	107.75	106.9	106.71	111.87

Efficiency of water heater 80.8 (216)

(217)m=	88.73	88.54	87.99	86.52	83.7	80.8	80.8	80.8	80.8	86.66	88.22	88.81	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	129.38	113.18	121.84	117.38	128.1	122.94	120.64	132.32	133.36	123.36	120.95	125.96

Total = Sum(219a)$_{1...12}$ = 1489.41 (219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2549.4	
Water heating fuel used			1489.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			322.66	(232)
Electricity generated by PVs			-576.34	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	550.67	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	321.71	(264)
Space and water heating	(261) + (262) + (263) + (264) =			872.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	167.46	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-299.12	(269)
Total CO2, kg/year		sum of (265)…(271) =		826.35	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.73	(273)
EI rating (section 14)				90	(274)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Lean First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	44.07	(1a)	x	3.03	(2a)	=	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02		x1/[1/(1.4)+ 0.04]	=	1.35			(27)
Windows Type 2			2.13		x1/[1/(1.4)+ 0.04]	=	2.82			(27)
Windows Type 3			0.52		x1/[1/(1.4)+ 0.04]	=	0.69			(27)
Windows Type 4			1.89		x1/[1/(1.4)+ 0.04]	=	2.51			(27)
Rooflights Type 1			0.52		x1/[1/(1.4) + 0.04]	=	0.728			(27b)
Rooflights Type 2			0.52		x1/[1/(1.4) + 0.04]	=	0.728			(27b)
Rooflights Type 3			0.52		x1/[1/(1.4) + 0.04]	=	0.728			(27b)
Rooflights Type 4			0.52		x1/[1/(1.4) + 0.04]	=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.57 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 36.21 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.91	25.76	25.61	24.92	24.79	24.19	24.19	24.07	24.42	24.79	25.05	25.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.12	61.97	61.82	61.13	61	60.4	60.4	60.28	60.63	61	61.26	61.54

Average = Sum(39)$_{1…12}$ /12= | 61.13 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.41	1.4	1.39	1.38	1.37	1.37	1.37	1.38	1.38	1.39	1.4

Average = Sum(40)$_{1…12}$ /12= | 1.39 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.52 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 70.26 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28

Total = Sum(44)$_{1…12}$ = | 843.09 | (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99

Total = Sum(45)$_{1…12}$ = | 1105.43 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	31.28	26.91	26.75	16.41	11.49	7.99	7.57	8.58	8.64	17.72	27.31	30.99	(63) (G2)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	93.51	81.94	86.93	85.87	88.27	80.83	79.11	86.91	87.63	90.45	86.47	91.11

Output from water heater (annual)1…12	1039.04	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	91.09	(66)

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

(67)m=	29.39	26.1	21.23	16.07	12.01	10.14	10.96	14.25	19.12	24.28	28.34	30.21	(67)

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

(68)m=	196.85	198.89	193.74	182.78	168.95	155.95	147.27	145.22	150.37	161.33	175.16	188.16	(68)

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

(69)m=	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	45.63	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)

Water heating gains (Table 5)

(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	376.68	373.33	359.46	338.28	316.94	297.39	285.97	292.25	304.38	325.71	349.44	367.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	456.46	518.74	581.83	650.03	696.98	687.69	656.89	610.61	557.65	492.91	446.78	434.3	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.86	0.72	0.54	0.4	0.45	0.68	0.9	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.8	19.99	20.29	20.63	20.87	20.97	20.99	20.99	20.92	20.61	20.15	19.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.92	0.82	0.65	0.45	0.29	0.33	0.59	0.86	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.5	18.91	19.38	19.66	19.77	19.78	19.78	19.73	19.37	18.73	18.18	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.31	19.66	20.06	20.31	20.42	20.44	20.44	20.38	20.04	19.5	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.16	19.51	19.91	20.16	20.27	20.29	20.29	20.23	19.89	19.35	18.89	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.97	0.96	0.92	0.83	0.68	0.49	0.34	0.38	0.62	0.86	0.95	0.98		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	444.25	495.58	533.04	537.22	470.83	334.11	221.49	232.14	347.65	426.31	426.34	424.56		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	908.74	883.56	804.11	672.97	516.34	342.42	222.79	234.32	371.36	566.73	750.26	903.79		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	345.58	260.72	201.67	97.73	33.85	0	0	0	0	104.47	233.23	356.55		
									Total per year (kWh/year) = Sum(98)1...5,9...12 =				1633.8	(98)
Space heating requirement in kWh/m²/year													37.07	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	345.58	260.72	201.67	97.73	33.85	0	0	0	0	104.47	233.23	356.55		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	380.17	286.82	221.86	107.52	37.24	0	0	0	0	114.93	256.57	392.24		
									Total (kWh/year) =Sum(211)1...5,10...12=				1797.37	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)1...5,10...12=				0	(215)
Water heating														
Output from water heater (calculated above)														
	93.51	81.94	86.93	85.87	88.27	80.83	79.11	86.91	87.63	90.45	86.47	91.11		
Efficiency of water heater													80.8	(216)
(217)m=	88.54	88.26	87.6	85.88	83.37	80.8	80.8	80.8	80.8	85.92	87.93	88.64		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	105.61	92.84	99.24	99.99	105.89	100.03	97.91	107.56	108.45	105.27	98.35	102.78		
									Total = Sum(219a)1...12 =				1223.93	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1797.37

Water heating fuel used			1223.93	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			207.61	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	62.55	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	42.59	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	27.38	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	274.29	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.29	(257)
SAP rating (Section 12)		81.96	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	388.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	264.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =			652.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	107.75	(268)
Total CO2, kg/year		sum of (265)…(271) =		845.98	(272)
CO2 emissions per m²		(272) ÷ (4) =		19.2	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2192.79	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1493.19	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3685.98	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	506.55	(267)
Electricity for lighting	(232)	x	0	=	637.37	(268)
'Total Primary Energy			sum of (265)…(271) =		4829.89	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		109.6	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Lean First Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	44.07	(1a)	x	3.03	(2a)	=	133.53	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	44.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	133.53	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.22	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			1.02	x1/[1/(1.4)+ 0.04]		=	1.35			(27)
Windows Type 2			2.13	x1/[1/(1.4)+ 0.04]		=	2.82			(27)
Windows Type 3			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Windows Type 4			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Rooflights Type 1			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 2			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 3			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Rooflights Type 4			0.52	x1/[1/(1.4) + 0.04]		=	0.728			(27b)
Walls	43	7.45	35.55	x	0.16	=	5.69			(29)
Roof	50.39	2.08	48.31	x	0.12	=	5.8			(30)
Total area of elements, m²			93.39							(31)
Party wall			40.32	x	0	=	0			(32)
Party floor			44.07							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 24.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.57 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 36.21 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.91	25.76	25.61	24.92	24.79	24.19	24.19	24.07	24.42	24.79	25.05	25.33	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.12	61.97	61.82	61.13	61	60.4	60.4	60.28	60.63	61	61.26	61.54	

Average = Sum(39)$_{1\ldots12}$ /12= | 61.13 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.41	1.41	1.4	1.39	1.38	1.37	1.37	1.37	1.38	1.38	1.39	1.4

Average = Sum(40)$_{1\ldots12}$ /12= | 1.39 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.52 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 70.26 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	77.28	74.47	71.66	68.85	66.04	63.23	63.23	66.04	68.85	71.66	74.47	77.28

Total = Sum(44)$_{1\ldots12}$ = | 843.09 | (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	114.61	100.24	103.44	90.18	86.53	74.67	69.19	79.4	80.35	93.63	102.21	110.99

Total = Sum(45)$_{1\ldots12}$ = | 1105.43 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	17.19	15.04	15.52	13.53	12.98	11.2	10.38	11.91	12.05	14.05	15.33	16.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.38	34.28	36.52	33.95	33.65	31.18	32.22	33.65	33.95	36.52	36.73	39.38	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.99	134.52	139.96	124.13	120.18	105.85	101.41	113.05	114.3	130.15	138.94	150.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	32.65	27.9	27.7	18.7	12.5	7.99	7.57	8.58	8.64	20.63	28.35	32.3	(63) (G2)
WWHRS	-27.31	-24.02	-24.52	-20.23	-18.81	-15.53	-13.18	-15.95	-16.4	-20.23	-23.39	-26.38	(63) (G10)

Output from water heater

(64)m=	92.15	80.95	85.98	83.58	87.26	80.83	79.11	86.91	87.63	87.53	85.43	89.8

Output from water heater (annual)$_{1...12}$ 1027.16 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.95	41.9	43.52	38.47	37.18	32.62	31.06	34.81	35.2	40.26	43.17	46.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	75.91	(66)

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

(67)m=	11.76	10.44	8.49	6.43	4.81	4.06	4.38	5.7	7.65	9.71	11.33	12.08	(67)

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

(68)m=	131.89	133.26	129.81	122.47	113.2	104.49	98.67	97.3	100.75	108.09	117.36	126.07	(68)

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

(69)m=	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	30.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	-60.73	(71)

Water heating gains (Table 5)

(72)m=	64.45	62.35	58.5	53.43	49.98	45.31	41.75	46.79	48.89	54.12	59.95	62.84	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.87	261.82	252.57	238.1	223.76	209.63	200.57	205.56	213.06	227.69	244.42	256.76	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.02	x	10.63	x	0.76	x	0.7	=	4	(74)
North	0.9x	0.77	x	2.13	x	10.63	x	0.76	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	1.02	x	20.32	x	0.76	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	2.13	x	20.32	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.02	x	34.53	x	0.76	x	0.7	=	12.99	(74)
North	0.9x	0.77	x	2.13	x	34.53	x	0.76	x	0.7	=	27.12	(74)
North	0.9x	0.77	x	1.02	x	55.46	x	0.76	x	0.7	=	20.86	(74)
North	0.9x	0.77	x	2.13	x	55.46	x	0.76	x	0.7	=	43.56	(74)
North	0.9x	0.77	x	1.02	x	74.72	x	0.76	x	0.7	=	28.1	(74)
North	0.9x	0.77	x	2.13	x	74.72	x	0.76	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	1.02	x	79.99	x	0.76	x	0.7	=	30.08	(74)
North	0.9x	0.77	x	2.13	x	79.99	x	0.76	x	0.7	=	62.81	(74)
North	0.9x	0.77	x	1.02	x	74.68	x	0.76	x	0.7	=	28.08	(74)
North	0.9x	0.77	x	2.13	x	74.68	x	0.76	x	0.7	=	58.64	(74)
North	0.9x	0.77	x	1.02	x	59.25	x	0.76	x	0.7	=	22.28	(74)
North	0.9x	0.77	x	2.13	x	59.25	x	0.76	x	0.7	=	46.52	(74)
North	0.9x	0.77	x	1.02	x	41.52	x	0.76	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	2.13	x	41.52	x	0.76	x	0.7	=	32.6	(74)
North	0.9x	0.77	x	1.02	x	24.19	x	0.76	x	0.7	=	9.1	(74)
North	0.9x	0.77	x	2.13	x	24.19	x	0.76	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.02	x	13.12	x	0.76	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	2.13	x	13.12	x	0.76	x	0.7	=	10.3	(74)
North	0.9x	0.77	x	1.02	x	8.86	x	0.76	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	2.13	x	8.86	x	0.76	x	0.7	=	6.96	(74)
South	0.9x	0.77	x	0.52	x	46.75	x	0.76	x	0.7	=	8.96	(78)
South	0.9x	0.77	x	1.89	x	46.75	x	0.76	x	0.7	=	32.58	(78)
South	0.9x	0.77	x	0.52	x	76.57	x	0.76	x	0.7	=	14.68	(78)
South	0.9x	0.77	x	1.89	x	76.57	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	0.77	x	0.52	x	97.53	x	0.76	x	0.7	=	18.7	(78)
South	0.9x	0.77	x	1.89	x	97.53	x	0.76	x	0.7	=	67.96	(78)
South	0.9x	0.77	x	0.52	x	110.23	x	0.76	x	0.7	=	21.13	(78)
South	0.9x	0.77	x	1.89	x	110.23	x	0.76	x	0.7	=	76.81	(78)
South	0.9x	0.77	x	0.52	x	114.87	x	0.76	x	0.7	=	22.02	(78)
South	0.9x	0.77	x	1.89	x	114.87	x	0.76	x	0.7	=	80.04	(78)
South	0.9x	0.77	x	0.52	x	110.55	x	0.76	x	0.7	=	21.19	(78)
South	0.9x	0.77	x	1.89	x	110.55	x	0.76	x	0.7	=	77.03	(78)

DER WorkSheet: New dwelling design stage

compliance testing consulting
build energy

South	0.9x	0.77	x	0.52	x	108.01	x	0.76	x	0.7	=	20.71	(78)
South	0.9x	0.77	x	1.89	x	108.01	x	0.76	x	0.7	=	75.26	(78)
South	0.9x	0.77	x	0.52	x	104.89	x	0.76	x	0.7	=	20.11	(78)
South	0.9x	0.77	x	1.89	x	104.89	x	0.76	x	0.7	=	73.09	(78)
South	0.9x	0.77	x	0.52	x	101.89	x	0.76	x	0.7	=	19.53	(78)
South	0.9x	0.77	x	1.89	x	101.89	x	0.76	x	0.7	=	70.99	(78)
South	0.9x	0.77	x	0.52	x	82.59	x	0.76	x	0.7	=	15.83	(78)
South	0.9x	0.77	x	1.89	x	82.59	x	0.76	x	0.7	=	57.55	(78)
South	0.9x	0.77	x	0.52	x	55.42	x	0.76	x	0.7	=	10.62	(78)
South	0.9x	0.77	x	1.89	x	55.42	x	0.76	x	0.7	=	38.61	(78)
South	0.9x	0.77	x	0.52	x	40.4	x	0.76	x	0.7	=	7.74	(78)
South	0.9x	0.77	x	1.89	x	40.4	x	0.76	x	0.7	=	28.15	(78)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	26	x	0.76	x	0.7	=	6.47	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	54	x	0.76	x	0.7	=	13.44	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	96	x	0.76	x	0.7	=	23.9	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	150	x	0.76	x	0.7	=	37.35	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	192	x	0.76	x	0.7	=	47.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	200	x	0.76	x	0.7	=	49.8	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	189	x	0.76	x	0.7	=	47.06	(82)
Rooflights	0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)

Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	157	x	0.76	x	0.7	=	39.09	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	115	x	0.76	x	0.7	=	28.63	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	66	x	0.76	x	0.7	=	16.43	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	33	x	0.76	x	0.7	=	8.22	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)
Rooflights 0.9x	1	x	0.52	x	21	x	0.76	x	0.7	=	5.23	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	79.78	145.41	222.37	311.74	380.05	390.29	370.92	318.36	253.27	167.2	97.34	67.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.65	407.23	474.94	549.84	603.8	599.92	571.49	523.92	466.33	394.89	341.76	323.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.79	0.61	0.46	0.51	0.77	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.79	20.11	20.51	20.81	20.95	20.99	20.98	20.88	20.47	19.95	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.76	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.77	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.88	0.72	0.51	0.33	0.39	0.67	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.21	18.67	19.23	19.61	19.76	19.78	19.78	19.69	19.19	18.45	17.87	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.82	19.06	19.45	19.93	20.26	20.41	20.44	20.43	20.33	19.88	19.26	18.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.67	18.91	19.3	19.78	20.11	20.26	20.29	20.28	20.18	19.73	19.11	18.63	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.74	0.55	0.39	0.44	0.71	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	340.09	398.69	452.29	484.34	447.6	328.47	220.41	230.19	330.12	364.24	335.04	321.2	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	892.45	868.32	791.36	664.81	512.91	341.6	222.61	234.02	368.79	557.08	736.04	887.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	410.96	315.59	252.27	129.94	48.59	0	0	0	0	143.47	288.72	421.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2011.08 (98)

Space heating requirement in kWh/m²/year 45.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	410.96	315.59	252.27	129.94	48.59	0	0	0	0	143.47	288.72	421.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	452.1	347.19	277.52	142.95	53.46	0	0	0	0	157.84	317.62	463.74	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2212.41 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	92.15	80.95	85.98	83.58	87.26	80.83	79.11	86.91	87.63	87.53	85.43	89.8	
Efficiency of water heater												80.8	(216)
(217)m=	88.87	88.64	88.1	86.66	84.14	80.8	80.8	80.8	80.8	86.79	88.38	88.95	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	103.69	91.32	97.59	96.44	103.7	100.03	97.91	107.56	108.45	100.86	96.67	100.96

Total = Sum(219a)$_{1...12}$ = 1205.2 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2212.41

Water heating fuel used		1205.2	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	120		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	165	(231)
Electricity for lighting		207.61	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	477.88	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	260.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			738.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	107.75	(268)
Total CO2, kg/year		sum of (265)…(271) =		931.59	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.14	(273)
EI rating (section 14)				86	(274)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Lean Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.43	(1a) x	2.42	(2a) =	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.01	31.85	31.71	31.01	30.88	30.28	30.28	30.17	30.51	30.88	31.15	31.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.53	71.38	71.23	70.54	70.41	69.8	69.8	69.69	70.04	70.41	70.67	70.95	

Average = Sum(39)$_{1…12}$ /12= 70.54 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1.01

Average = Sum(40)1…12 /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57

Total = Sum(44)1…12 = 1053.51 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69

Total = Sum(45)1…12 = 1381.32 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	35.11	30.78	29.8	19.28	13.28	9.73	9.24	10.45	10.53	20.47	30.52	34.86	(63) (G2)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	117.3	102.13	109.09	105.96	109.02	99.33	97.47	106.92	107.75	112.17	108.69	114.29	

Output from water heater (annual)1…12 | 1290.12 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	135.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.68	40.57	32.99	24.98	18.67	15.76	17.03	22.14	29.72	37.73	44.04	46.94	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	295.97	299.04	291.3	274.82	254.03	234.48	221.42	218.35	226.09	242.56	263.36	282.91	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)
Water heating gains (Table 5)													
(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	528.11	523.44	503.32	472.5	441.07	412.78	396.55	404.88	422.82	453.84	488.24	514.3	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)

North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)
North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	586.94	637.82	693.25	756.99	799.62	784.96	748.71	700.2	645.71	589.68	561.39	562.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.45	0.71	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.29	20.5	20.76	20.93	20.99	21	21	20.96	20.74	20.41	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.87	0.7	0.48	0.33	0.37	0.63	0.9	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.97	19.15	19.46	19.81	20.02	20.08	20.09	20.09	20.06	19.8	19.34	18.94	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.47	19.62	19.89	20.21	20.4	20.46	20.47	20.47	20.43	20.19	19.78	19.43	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.32	19.47	19.74	20.06	20.25	20.31	20.32	20.32	20.28	20.04	19.63	19.28	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.86	0.71	0.5	0.35	0.39	0.65	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	577.5	620.95	655.22	654.78	566.32	394.31	259.06	272.2	417.13	527.88	544.67	555.42	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1074.09	1040.21	943.06	786.96	601.73	398.55	259.47	272.99	433.17	664.96	885.66	1070.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	369.46	281.74	214.15	95.17	26.34	0	0	0	0	101.98	245.51	382.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1717.24 (98)

Space heating requirement in kWh/m²/year 24.38 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	369.46	281.74	214.15	95.17	26.34	0	0	0	0	101.98	245.51	382.88	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	406.45	309.95	235.59	104.7	28.98	0	0	0	0	112.19	270.09	421.21	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1889.15 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	117.3	102.13	109.09	105.96	109.02	99.33	97.47	106.92	107.75	112.17	108.69	114.29

Efficiency of water heater 80.8 (216)

(217)m=	88.24	87.97	87.22	85.28	82.59	80.8	80.8	80.8	80.8	85.31	87.54	88.36	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	132.93	116.09	125.07	124.24	132.01	122.94	120.64	132.32	133.36	131.47	124.16	129.34

Total = Sum(219a)$_{1...12}$ = 1524.57 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1889.15	
Water heating fuel used			1524.57	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			322.66	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	65.74	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	53.06	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	21.76	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	42.56	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			303.12	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.1	(257)
SAP rating (Section 12)		84.61	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating (main system 1)	(211) x	0.216	=	408.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	329.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =			737.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	85.64	(267)
Electricity for lighting	(232) x	0.519	=	167.46	(268)
Total CO_2, kg/year		sum of (265)…(271) =		990.46	(272)
CO_2 emissions per m²		(272) ÷ (4) =		14.06	(273)

SAP WorkSheet: New dwelling design stage

EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2304.77	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1859.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4164.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	506.55	(267)
Electricity for lighting	(232) x	0	=	990.56	(268)
‘Total Primary Energy		sum of (265)…(271) =		5661.85	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		80.39	(273)

DER WorkSheet: New dwelling design stage

compliance testing consulting

User Details:

Assessor Name:	Peter Mitchell	**Stroma Number:**	STRO007945
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.6

Property Address: Lean Ground Floor Sample

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.43	(1a) x	2.42	(2a) =	170.44	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.43	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.44	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			3.98	x1/[1/(1.4)+ 0.04]		=	5.28			(27)
Windows Type 2			5.97	x1/[1/(1.4)+ 0.04]		=	7.91			(27)
Floor			70.43	x	0.12	=	8.4516			(28)
Walls	40.03	11.84	28.19	x	0.16	=	4.51			(29)
Total area of elements, m²			110.46							(31)
Party wall			45.23	x	0	=	0			(32)
Party ceiling			70.43							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.35 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 39.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	32.01	31.85	31.71	31.01	30.88	30.28	30.28	30.17	30.51	30.88	31.15	31.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.53	71.38	71.23	70.54	70.41	69.8	69.8	69.69	70.04	70.41	70.67	70.95	

Average = Sum(39)$_{1…12}$ /12= 70.54 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.01	1.01	1	1	0.99	0.99	0.99	0.99	1	1	1.01

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.26 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.79 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	96.57	93.06	89.55	86.04	82.52	79.01	79.01	82.52	86.04	89.55	93.06	96.57

Total = Sum(44)$_{1…12}$ = 1053.51 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.21	125.25	129.25	112.68	108.12	93.3	86.46	99.21	100.4	117	127.72	138.69

Total = Sum(45)$_{1…12}$ = 1381.32 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.48	18.79	19.39	16.9	16.22	14	12.97	14.88	15.06	17.55	19.16	20.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.21	42.83	45.63	42.43	42.05	38.97	40.26	42.05	42.43	45.63	45.89	49.21	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	192.42	168.09	174.88	155.11	150.18	132.27	126.72	141.27	142.83	162.64	173.61	187.91	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	37.61	32.69	31.68	23.69	15.09	9.73	9.24	10.45	10.53	25.73	32.5	37.28	(63) (G2)
WWHRS	-37.65	-33.13	-33.81	-27.84	-25.86	-21.34	-18.07	-21.88	-22.51	-27.81	-32.2	-36.39	(63) (G10)

Output from water heater

(64)m=	114.8	100.21	107.2	101.55	107.21	99.33	97.47	106.92	107.75	106.9	106.71	111.87	

Output from water heater (annual)$_{1...12}$ 1267.93 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	59.92	52.36	54.38	48.07	46.46	40.76	38.81	43.5	43.99	50.31	53.94	58.42	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	112.83	(66)

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

(67)m=	18.27	16.23	13.2	9.99	7.47	6.31	6.81	8.86	11.89	15.09	17.61	18.78	(67)

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

(68)m=	198.3	200.36	195.17	184.13	170.2	157.1	148.35	146.29	151.48	162.52	176.45	189.55	(68)

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

(69)m=	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	34.28	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	-90.26	(71)

Water heating gains (Table 5)

(72)m=	80.54	77.91	73.1	66.77	62.45	56.62	52.17	58.47	61.1	67.62	74.92	78.52	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	363.96	361.34	348.31	327.74	306.97	286.87	274.18	280.47	291.31	312.08	335.83	353.69	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.98	x	10.63	x	0.76	x	0.7	=	15.6	(74)
North	0.9x	0.77	x	3.98	x	20.32	x	0.76	x	0.7	=	29.82	(74)
North	0.9x	0.77	x	3.98	x	34.53	x	0.76	x	0.7	=	50.67	(74)

North	0.9x	0.77	x	3.98	x	55.46	x	0.76	x	0.7	=	81.38	(74)
North	0.9x	0.77	x	3.98	x	74.72	x	0.76	x	0.7	=	109.63	(74)
North	0.9x	0.77	x	3.98	x	79.99	x	0.76	x	0.7	=	117.36	(74)
North	0.9x	0.77	x	3.98	x	74.68	x	0.76	x	0.7	=	109.58	(74)
North	0.9x	0.77	x	3.98	x	59.25	x	0.76	x	0.7	=	86.93	(74)
North	0.9x	0.77	x	3.98	x	41.52	x	0.76	x	0.7	=	60.92	(74)
North	0.9x	0.77	x	3.98	x	24.19	x	0.76	x	0.7	=	35.49	(74)
North	0.9x	0.77	x	3.98	x	13.12	x	0.76	x	0.7	=	19.25	(74)
North	0.9x	0.77	x	3.98	x	8.86	x	0.76	x	0.7	=	13.01	(74)
East	0.9x	1	x	5.97	x	19.64	x	0.76	x	0.7	=	43.23	(76)
East	0.9x	1	x	5.97	x	38.42	x	0.76	x	0.7	=	84.56	(76)
East	0.9x	1	x	5.97	x	63.27	x	0.76	x	0.7	=	139.26	(76)
East	0.9x	1	x	5.97	x	92.28	x	0.76	x	0.7	=	203.11	(76)
East	0.9x	1	x	5.97	x	113.09	x	0.76	x	0.7	=	248.92	(76)
East	0.9x	1	x	5.97	x	115.77	x	0.76	x	0.7	=	254.81	(76)
East	0.9x	1	x	5.97	x	110.22	x	0.76	x	0.7	=	242.59	(76)
East	0.9x	1	x	5.97	x	94.68	x	0.76	x	0.7	=	208.38	(76)
East	0.9x	1	x	5.97	x	73.59	x	0.76	x	0.7	=	161.97	(76)
East	0.9x	1	x	5.97	x	45.59	x	0.76	x	0.7	=	100.34	(76)
East	0.9x	1	x	5.97	x	24.49	x	0.76	x	0.7	=	53.9	(76)
East	0.9x	1	x	5.97	x	16.15	x	0.76	x	0.7	=	35.55	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.83	114.38	189.93	284.49	358.55	372.18	352.17	295.32	222.89	135.84	73.15	48.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	422.79	475.72	538.24	612.23	665.51	659.05	626.35	575.78	514.2	447.92	408.98	402.25	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.84	0.65	0.49	0.55	0.82	0.97	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.08	20.31	20.63	20.87	20.98	21	20.99	20.92	20.59	20.21	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.39	0.44	0.75	0.96	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.66	18.85	19.2	19.65	19.96	20.08	20.09	20.09	20.02	19.61	19.06	18.62	(90)

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.19	19.36	19.66	20.05	20.34	20.45	20.47	20.46	20.39	20.02	19.54	19.16	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.04	19.21	19.51	19.9	20.19	20.3	20.32	20.31	20.24	19.87	19.39	19.01	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.8	0.59	0.41	0.47	0.76	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	421.21	472.09	527.03	569.24	532.4	388.51	258.35	270.71	393.36	429.52	405.8	401.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1054.42	1021.4	926.76	776.2	597.6	397.84	259.37	272.79	430.27	652.54	868.24	1050.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	471.11	369.14	297.39	149.01	48.51	0	0	0	0	165.93	332.96	483.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2317.4 (98)

Space heating requirement in kWh/m²/year 32.9 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	471.11	369.14	297.39	149.01	48.51	0	0	0	0	165.93	332.96	483.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	518.27	406.09	327.16	163.93	53.37	0	0	0	0	182.54	366.29	531.75	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2549.4 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	114.8	100.21	107.2	101.55	107.21	99.33	97.47	106.92	107.75	106.9	106.71	111.87	
Efficiency of water heater												80.8	(216)
(217)m=	88.73	88.54	87.99	86.52	83.7	80.8	80.8	80.8	80.8	86.66	88.22	88.81	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	129.38	113.18	121.84	117.38	128.1	122.94	120.64	132.32	133.36	123.36	120.95	125.96	

Total = Sum(219a)$_{1...12}$ = 1489.41 (219)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2549.4	
Water heating fuel used			1489.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		165	(231)
Electricity for lighting			322.66	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	550.67	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	321.71	(264)
Space and water heating	(261) + (262) + (263) + (264) =				872.38	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	85.64	(267)
Electricity for lighting	(232)	x	0.519	=	167.46	(268)
Total CO2, kg/year			sum of (265)…(271) =		1125.48	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.98	(273)
EI rating (section 14)					87	(274)

Appendix C - Non- Domestic Results Tables

Cumulative Emissions & Savings

The following tables are presented in accordance with the advice presented within 'Energy Planning - Greater London Authority guidance on preparing energy assessments'.

	Carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	2.90	3.02
After energy demand reduction	2.41	3.02
After heat network / CHP	2.41	3.02
After renewable energy	1.87	3.02

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchyfor non-domestic buildings

	Regulated Carbon dioxide savings	
	(Tonnes CO_2 / annum)	**(%)**
Savings from energy demand reduction	0.50	17.09
Savings from heat network / CHP	0.00	0.00
Savings from renewable energy	0.54	18.59
Total Cumulative Savings	**1.04**	**35.68**
Total Target Savings	1.02	35.00
Annual Surplus	0.02	

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

Results by Plot

Baseline

Baseline: Part L 2013 of the Building Regulations Compliant Development	**Non-Domestic Total (Sum)**	Commercial
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**2.904**	2.904

Be Lean

After energy demand reduction	**Non-Domestic Total (Sum)**	Commercial
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**2.904**	2.904
Be Lean	**2.408**	2.408
% Improvement	**17.09**	17.09

Be Lean & Clean

After heat network / CHP	**Non-Domestic Total (Sum)**	Commercial
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**2.904**	2.904
Be Lean & Clean	**2.408**	2.408
% Improvement	**17.09**	17.09

Be Lean, Clean & Green

After renewable energy	**Non-Domestic Total (Sum)**	Commercial
	Cumulative CO_2 Emissions (tonnes CO_2 per annum)	Cumulative CO_2 Emissions (tonnes CO_2 per annum)
Baseline	**2.904**	2.904
Be Lean, Clean & Green	**1.868**	1.868
% Improvement	**35.68**	35.68

Unregulated Emissions

Emissions from Sources not Regulated under Part L of the Building Regulations (Tonnes CO2 / annum)	**Non-Domestic Total (Sum)**	Commercial
	3.02	3.02

Build Energy Ltd Unit 6 Silver Business Park Airfield Way Christchurch Dorset BH23 3TA
Company No. 07833780 VAT Reg.126036639 03/08/2016 11:43

Appendix D

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

74 Church Road

As designed

Date: Thu Jul 28 11:20:01 2016

Administrative information

Building Details

Address: Barnes, London, SW13 0DQ

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 CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	12.8
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	External Wall
Floor	0.25	0.12	0.12	Ground Floor
Roof	0.25	0.12	0.12	Roof/Internal Ceiling
Windows***, roof windows, and rooflights	2.2	1.4	1.4	W01 Lower
Personnel doors	2.2	1.5	1.5	W01 Lower - DOOR
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = 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
$m^3/(h.m^2)$ at 50 Pa	10	4

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- New HVAC System (5 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	4.5	-	1.4	0.8
Standard value	2.5*	2.6	N/A	1.1^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ 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- New DHW Circuit

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
Commercial Unit 1	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 2	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 3	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 4	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 5	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Commercial Unit 1	90	-	-	208
Commercial Unit 2	90	-	-	210
Commercial Unit 3	90	-	-	207
Commercial Unit 4	90	-	-	211

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Commercial Unit 5	90	-	-	208

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?
Commercial Unit 1	NO (-47%)	NO
Commercial Unit 2	NO (-48%)	NO
Commercial Unit 3	NO (-47%)	NO
Commercial Unit 4	NO (-49%)	NO
Commercial Unit 5	NO (-66%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	139	139
External area [m^2]	283	283
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	4	5
Average conductance [W/K]	93	140
Average U-value [W/m^{2}K]	0.33	0.49
Alpha value* [%]	14.95	14.95

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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/m^2]

	Actual	Notional
Heating	0.93	2.94
Cooling	8.03	6.57
Auxiliary	3.63	3.47
Lighting	14.59	23.48
Hot water	2.89	3.17
Equipment*	41.87	41.87
TOTAL**	**30.07**	**39.64**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	5.42	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	129.1	116.71
Primary energy* [kWh/m^2]	92.31	112.64
Total emissions [kg/m^2]	12.8	19.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	12	117.1	0.9	8	3.6	3.6	4.05	4	4.5
	Notional	27	89.6	3.1	6.9	3.7	2.43	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

Element	**U_{i-Typ}**	**U_{i-Min}**	**Surface where the minimum value occurs***
Wall	0.23	0.16	External Wall
Floor	0.2	0.12	Ground Floor
Roof	0.15	0.12	Roof/Internal Ceiling
Windows, roof windows, and rooflights	1.5	1.4	Rooflights
Personnel doors	1.5	1.5	W01 Lower - DOOR
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	4

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

74 Church Road

As designed

Date: Thu Jul 28 12:04:27 2016

Administrative information

Building Details

Address: Barnes, London, SW13 0DQ

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 CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	16.5
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	External Wall
Floor	0.25	0.12	0.12	Ground Floor
Roof	0.25	0.12	0.12	Roof/Internal Ceiling
Windows***, roof windows, and rooflights	2.2	1.4	1.4	W01 Lower
Personnel doors	2.2	1.5	1.5	W01 Lower - DOOR
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = 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
$m^3/(h.m^2)$ at 50 Pa	10	4

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- New HVAC System (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4	-	1.4	0.8
Standard value	0.91*	2.6	N/A	1.1^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* 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- New DHW Circuit

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Commercial Unit 1	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 2	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 3	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 4	-	-	-	1.4	-	-	-	-	-	-	N/A
Commercial Unit 5	-	-	-	1.4	-	-	-	-	-	-	N/A

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Commercial Unit 1	90	-	-	208
Commercial Unit 2	90	-	-	210
Commercial Unit 3	90	-	-	207
Commercial Unit 4	90	-	-	211

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Commercial Unit 5	90	-	-	208

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?
Commercial Unit 1	NO (-47%)	NO
Commercial Unit 2	NO (-48%)	NO
Commercial Unit 3	NO (-47%)	NO
Commercial Unit 4	NO (-49%)	NO
Commercial Unit 5	NO (-66%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	139	139
External area [m²]	283	283
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	5
Average conductance [W/K]	93	140
Average U-value [W/m²K]	0.33	0.49
Alpha value* [%]	14.95	14.95

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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
Heating	4.07	8.73
Cooling	9.04	6.57
Auxiliary	3.63	3.47
Lighting	14.59	23.48
Hot water	2.89	3.17
Equipment*	41.87	41.87
TOTAL**	**34.21**	**45.43**

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	129.1	116.71
Primary energy* [kWh/m²]	97.51	114.48
Total emissions [kg/m²]	16.5	19.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	12	117.1	4.1	9	3.6	0.82	3.6	0.91	4
	Notional	27	89.6	9.1	6.9	3.7	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

Element	**U_{i-Typ}**	**U_{i-Min}**	**Surface where the minimum value occurs***
Wall	0.23	0.16	External Wall
Floor	0.2	0.12	Ground Floor
Roof	0.15	0.12	Roof/Internal Ceiling
Windows, roof windows, and rooflights	1.5	1.4	Rooflights
Personnel doors	1.5	1.5	W01 Lower - DOOR
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

U_{i-Typ} = Typical individual element U-values [W/(m²K)] U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	4

SBEM Input Parameters Summary

The following section gives details of various SBEM model parameters under relevant sub-headings used for the non-domestic elements of the proposed development at 74 Church Road, Barnes.

General

Calendar: NCM Standard

Weather: London TRY

Fabric Performance

Air Permeability: 4m^3/hr.m^2

Thermal Transmittance

Table 1 below gives details of the fabric performance of the building elements assumed in the model:

Building Element	g-value/ light transmittance	U-value (W/m2.K)	Construction
External Walls	n/a	0.16	Plasterboard lined inner blockwork, insulated cavity and brickwork outer skin.
Ground Floor	n/a	0.12	Screed over solid insulation and concrete floor slab.
Roof	n/a	0.12	Insulated concrete slab with plastered soffit internally.
Glazing / Rooflights	0.50 / 0.65	1.4	Triple glazed unit
External Doors	0.50 / 0.65	1.5	Pedestrian access doors
Internal Floors	n/a	1.4	False ceiling below concrete floor to above.
Party Walls	n/a	0.37	Insulated cavity wall, plasterboard lined on both sides.

Table 1

System Efficiencies

Electrical Power Factor: <0.90

Lighting

Control strategy typically follows the principles in Table 2 below:

Zone	Lighting Efficacy (LL/CW)	Auto Presence Switching	Daylight Control
Commercial Areas	90	Manual on, auto off	Photocell dimming

Table 2

As noted, the commercial spaces are to have photocell sensors throughout, with lighting dimmed automatically depending on levels of natural light in the space at any given time.

Assumed design illuminance of 400lux to commercial areas.

No time clock controls assumed to photocells. Parasitic power assumed as default 0.3 W/m^2.

Light metering with alarms warning of out-of-range values not included.

Ventilation

Zone	Ventilation Type	Extract Rate	Specific Fan Power (W/l.s)	Heat Recovery Efficiency (%)
Commercial Areas	VRF with Mechanical Supply and Extract	n/a	1.4	80

Table 3

Ventilation is assumed to have demand control, with fan speed varying automatically with occupancy.

Heat recovery assumed to be 80% using a thermal wheel heat exchanger.

Metering with alarms warning of out-of-range values not included.

Heating & Cooling

Heating and cooling is provided by an air source heat pump with a heating COP of 4.0 and cooling ESEER of 4.5.

Distribution efficiency for the heating system and cooling systems assumed to be as 90%.

Variable speed pumping is assumed, with multiple differential pressure sensors in the system.

Heat metering with alarms warning of out-of-range values not included.

Hot Water

Assumed to be point of use instantaneous electric water heating, without storage volumes.

Generation and distribution efficiency assumed to be 100%.

Renewables

8m^2 of photovoltaic array is proposed on the south-east facing pitched roof.

The array has an inclination of 15° from the horizontal.

Panels are assumed to have an efficiency of 15% and a solar conversion factor of 0.8.

Appendix F -Site Wide Results Tables

build energy

compliance
testing
consulting

Cumulative Emissions & Savings

The following tables are presented in accordance with the advice presented within 'Energy Planning - Greater London Authority guidance on preparing energy assessments'.

	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	8.28	2.98
After energy demand reduction	7.60	2.98
After heat network / CHP	7.60	2.98
After renewable energy	5.30	2.98

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings.

	Regulated Carbon dioxide savings	
	(Tonnes CO_2 / annum)	**(%)**
Savings from energy demand reduction	0.68	8.25
Savings from heat network / CHP	0.00	0.00
Savings from renewable energy	2.29	27.70
Cumulative on site Savings	2.98	35.96
Total Target Savings	2.90	35.00
Annual Surplus	**0.08**	

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	2.90	3.02
After energy demand reduction	2.41	3.02
After heat network / CHP	2.41	3.02
After renewable energy	1.87	3.02

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchyfor non-domestic buildings

	Regulated Carbon dioxide savings	
	(Tonnes CO_2 / annum)	**(%)**
Savings from energy demand reduction	0.50	17.09
Savings from heat network / CHP	0.00	0.00
Savings from renewable energy	0.54	18.59
Total Cumulative Savings	1.04	35.68
Total Target Savings	1.02	35.00
Annual Surplus	0.02	

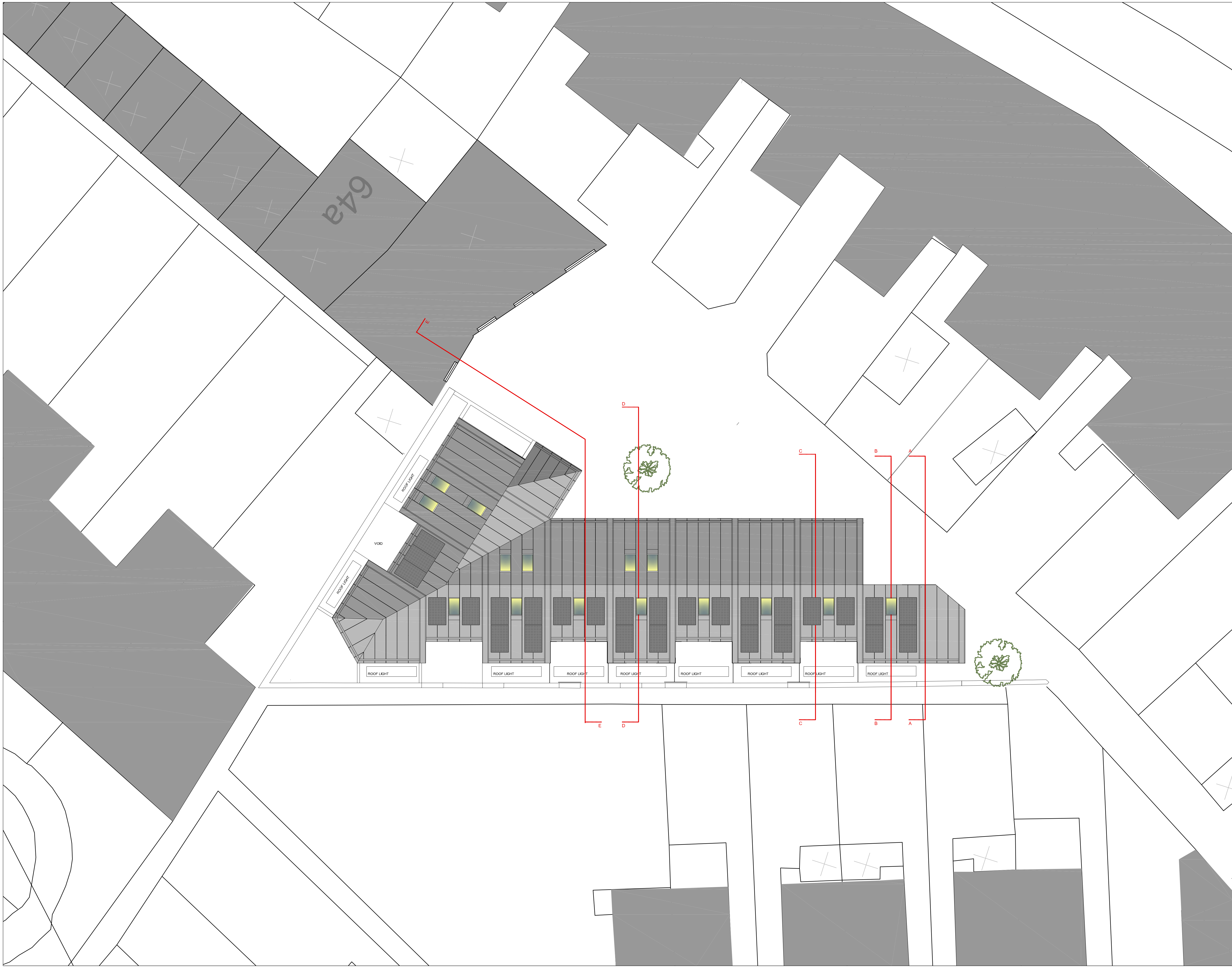
Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Total regulated emissions (Tonnes CO_2/year)	CO2 savings (Tonnes CO_2/year)	Percentage Saving (%)
Part L 2013 Baseline	11.18		
Be lean	10.00	1.18	10.55
Be clean	10.00	0.00	0.00
Be green	7.17	2.83	25.34

Table 6: Site wide regulated carbon dioxide emissions and savings

Total Savings	**4.01**	**35.88**

Appendix G - Possible PV Locations



NOTES

Do not scale from drawing.
All dimensions must be verified on site by the Contractor. Any discrepancies or omissions must be reported to the Architect immediately.

REV A 12/08/2016
23 1.6M2 P.V.PANELS ADDED

Anne Machin Architects

24a PETERSHAM MEWS LONDON SW7 5NR

Telephone 0207 5813652 Facsimile 0207 5813652

Project
74 CHURCH ROAD, BARNES, LONDON, SW13 0DQ, MIXED USE SCHEME

Client
THE BASINGHALL ESTATE Co Ltd

Drawing Title
PROPOSED ROOF PLAN

North	Scale	Drawn by
N	1:200 @ A3	
	Date: APRIL 2016	Checked by: -

Project No.	Drawing No.	Revision
1051	1051-APP-07	A

Appendix H – BREEAM Pre Assessment

build energy

compliance
testing
consulting

Criteria Summary

Project:	52388 - 74 Church Road Barnes London SW13 0DQ
Report:	Pre-Assessment Stage
Design Target:	Excellent - 72.42%
Potential Rating:	Outstanding - 91.32%

Management	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Man 01.1: Project brief and design : Stakeholder consultation	2	1.14%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Awarded on the basis that the stakeholder consultation has been an integral part of the concept design process and can be evidenced by the design team.						
Man 01.2: Project brief and design : Sustainability Champion	2	1.14%	2	1.14%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Appointment of Sustainability Champion throughout project will ensure targeted goals are achieved						
Man 02.1: Life cycle cost and service life planning: Elemental life cycle cost	2	1.14%	0	0%	1	0.57%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: This has not been completed at concept stage, however the design team may wish to consider achieving this credit.						
Man 02.2: Life cycle cost and service life planning: Components level life cycle cost	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: This credit can be achieved at RIBA stage 4 and will require LCC option appraisal in line with PD 156865:2008						
Man 02.3: Life cycle cost and service life planning: Capital cost reporting	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A commitment to capital cost reporting on completion supplied to BRE will comply with this credit						
Man 03.1: Responsible construction practices : Environmental management	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Contractor to demonstrate adherence to relevant environmental standard (EMS) eg. ISO14001 or equivalent.						
Man 03.2: Responsible construction practices : Construction stage Sustainability Champion	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Appointment of Sustainability Professional (AP) to monitor construction phase and oversee BREEAM certification optimisation.						
Man 03.3: Responsible construction practices : Considerate construction	2	1.14%	2	1.14%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Contractor must be considerate constructors (CC) registered, and in addition exceed CC requirements.						
Man 03.4: Responsible construction practices : Monitoring of construction site impacts	2	1.14%	2	1.14%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Construction monitoring will be required to provide robust reporting information, by a specified individual. An exemplary credit is available if the contractor demonstrates excellence relating to Considerate Constructors performance.						
Man 04.1: Commissioning and handover : Commissioning and testing schedule and responsibilities	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Contractor to formally identify commissioning schedule						
Man 04.2: Commissioning and handover : Commissioning building services	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: There will be appointment of a dedicated commissioning manager, to review building services installations						

Man 04.3: Commissioning and handover : Testing and inspecting building fabric	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A thermography survey will be carried out by a suitably qualified expert and any fabric defects will be rectified.						
Man 04.4: Commissioning and handover : Handover	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A building user guide will be prepared and distributed to occupants and building managers.						
Man 05.1: Aftercare : Aftercare support	1	0.57%	1	0.57%	0	0%
Man 05.2: Aftercare : Seasonal commissioning	1	0.57%	1	0.57%	0	0%
Man 05.3: Aftercare : Post occupancy evaluation	1	0.57%	1	0.57%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Commitment to complete Post Occupancy Evaluation after completion						
Management Totals	**21**	**12.00%**	**18**	**10.28%**	**1**	**0.57%**

Health and Wellbeing	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Hea 01.1: Visual comfort : Glare control	1	0.79%	1	0.79%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: In order to award many of these credits in this section full Dynamic Simulation modelling is required. This model will assist in all aspects of the energy calculation and also allow for thermal comfort reports to be run. Using CIBSE future weather data files, predictions may be made to assist in demonstrating the impact with regard to future climate change, as required under The London Plan. Glare has been considered and designed out where possible with the strategy to maximise daylight whilst reducing energy consumption.						
Hea 01.2: Visual comfort : Daylighting	2	1.58%	1	0.79%	1	0.79%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Average daylight factors have been calculated and meet good practice for office accommodation.						
Hea 01.3: Visual comfort : View out	2	1.58%	1	0.79%	1	0.79%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The design team confirm 95% of floor area is within 7m of a wall which has a permanent window opening with a view out.						
Hea 01.4: Visual comfort : Internal and external lighting, Zoning and control	1	0.79%	1	0.79%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Internal and external lighting will be designed to CIBSE standards to minimise energy consumption and to provide appropriate lighting levels for occupants. Design will incorporate individual user controls.						
Hea 02.1: Indoor air quality : Minimising sources of air pollution	4	3.16%	2	1.58%	2	1.58%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The design team will produce an indoor air quality plan to ensure removal of contaminant sources etc. All VOCs will be designed out from products.						
Hea 02.2: Indoor air quality : Adaptability - potential for natural ventilation	1	0.79%	0	0%	1	0.79%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The building has been designed with an appropriate ventilation strategy, for flexible and adaptable use in a number of different climate scenarios. The strategy provides at least tow levels of user controls.						
Hea 04: Thermal comfort	3	2.37%	3	2.37%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: See earlier comments in HEA01 about thermal modelling. This has accounted for optimum design temperatures, a range of climate change scenarios and thermal zoning.						
Hea 05.1: Acoustic performance : Education, Healthcare, Office and Law Courts building types	3	2.37%	3	2.37%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A suitable qualified acoustician will be asked to comment and assist on the project and his recommendations taken forward on the project.						
Hea 06: Safety and security	2	1.58%	1	0.79%	1	0.79%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A suitably qualified Security Expert will be asked to comment and assist on the project and his recommendations taken forward on the project.						

Health and Wellbeing Totals	**19**	**15.00%**	**13**	**10.26%**	**6**	**4.73%**

Energy	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Ene 01: Reduction of energy use and carbon emissions	12	8.57%	7	5%	2	1.43%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Through the use of low energy, high efficiency ASHP, and low energy lighting achieved through a full lighting design and sealing air leakage point/controlling thermal bridges, the project will demonstrate a significant improvement over the benchmark notional building.						
Ene 02: Energy monitoring	2	1.43%	2	1.43%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Smart energy metering and sub metering will be installed.						
Ene 03: External lighting	1	0.71%	1	0.71%	0	0%
Ene 04.1: Low carbon design : Passive design	2	1.43%	1	0.71%	1	0.71%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The project team has carried out passive design analysis in compliance with HEA01 at concept design stage and has reviewed all passive design measures to reduce the energy loads, designing these into the scheme where possible.						
Ene 04.2: Low carbon design : Low or zero carbon technologies	1	0.71%	1	0.71%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A feasibility study has been carried out by Build Energy and LZC technologies have been included in the scheme where possible.						
Ene 08: Energy efficient equipment	2	1.43%	1	0.71%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: High performance unregulated appliances will be specified						
Ene 09: Drying space	1	0.71%	1	0.71%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Adequate drying space will be provided.						
Energy Totals	**21**	**15.00%**	**14**	**10.00%**	**3**	**2.14%**

Transport	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Tra 01.1: Public transport accessibility : Accessibility Index	5	3.75%	4	3%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: PTAL AI score of 14 equating to 4 credits						
Tra 02: Proximity to amenities	2	1.5%	2	1.5%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A review on Google maps indicates that sufficient qualifying amenities are available close to the site. This will need to be confirmed.						
Tra 03: Cyclist facilities	2	1.5%	1	0.75%	1	0.75%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: These credits will be targeted, final amendments to design may be necessary						
Tra 04: Maximum car parking capacity	2	1.5%	2	1.5%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Confirmation of residential parking is required to make final calculation						
Tra 05: Travel plan	1	0.75%	0	0%	1	0.75%
Transport Totals	**12**	**9.00%**	**9**	**6.75%**	**2**	**1.50%**

Water	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Wat 01: Water consumption	5	3.89%	4	3.11%	1	0.77%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The scheme aims to ensure a 50% saving over BREEAM benchmark performance, which would significantly improve on compliance with Part G building regulations.						
Wat 02: Water monitoring	1	0.78%	1	0.78%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A water meter will be supplied with sub-meters where necessary.						
Wat 03: Water leak detection	2	1.56%	2	1.56%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Leak detection and flow control devices will be provided.						

Wat 04: Water efficient equipment	1	0.78%	1	0.78%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The scheme will undertake a commitment to installation of unregulated water consuming appliances.						
Water Totals	**9**	**7.00%**	**8**	**6.22%**	**1**	**0.77%**

Materials	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Mat 01: Life cycle impacts	6	5.79%	4	3.85%	2	1.93%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Use of low environmental impact (including embodied carbon) materials in the main building fabric over the full life cycle of the building. An exemplary credit is available for specification of materials from the Green Guide.						
Mat 02: Hard landscaping and boundary protection	1	0.96%	0	0%	1	0.96%
Mat 03: Responsible sourcing of materials	4	3.86%	3	2.89%	1	0.96%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: All timber and timber based products will be legally harvested. A sustainable procurement plan will be submitted by the main contractor. Compliance with BREEAM methodology for responsible sourcing of materials - 2 credits.						
Mat 04: Insulation	1	0.96%	1	0.96%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: New insulation will be assessed for performance against the BREEAM insulation index.						
Mat 05: Designing for durability and resilience	1	0.96%	1	0.96%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Suitable protection measures and resistance to degradation will be considered and implemented.						
Mat 06: Material efficiency	1	0.96%	0	0%	0	0%
Materials Totals	**14**	**13.50%**	**9**	**8.67%**	**4**	**3.85%**

Waste	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Wst 01.1: Construction waste management : Construction resource efficiency	3	2.83%	3	2.83%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Assumption of <3.4m3 waste generated per 100m2 (GIFA)						
Wst 01.2: Construction waste management : Diversion of resources from landfill	1	0.94%	1	0.94%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Non demolition waste of 70% and Demolition waste of 80% by volume will be diverted from landfill. Waste will be segregated on site.						
Wst 02: Recycled aggregates	1	0.94%	1	0.94%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The percentage of high grade aggregate that is recycled will meet required limits by volume per element.						
Wst 03: Operational waste	1	0.94%	1	0.94%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Space will be provided on site for segregation of waste streams.						
Wst 04: Speculative floor and ceiling finishes	1	0.94%	1	0.94%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Fit out work for tenants will take place to less than 25% of the net lettable floor area, to avoid unnecessary refurbishment on tenancy.						
Wst 05: Adaptation to climate change	1	0.94%	1	0.94%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The scheme has been reviewed for potential adaptation to different climate change scenarios.						
Wst 06: Functional adaptability	1	0.94%	0	0%	0	0%
Waste Totals	**9**	**8.50%**	**8**	**7.55%**	**0**	**0.00%**

Land Use and Ecology	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
LE 01.1: Site selection : Previously occupied land	1	1%	1	1%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016:						

This is a brownfield development with at least 75% of the proposed development's footprint having been developed before. A contaminated land site investigation carried out by a suitably qualified professional will be carried out.						
LE 01.2: Site selection : Contaminated land	1	1%	1	1%	0	0%
LE 02: Ecological value of site and protection of ecological features	2	2%	2	2%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The site has been evalued as low ecological value according to BREEAM checklist. A suitably qualified ecologist will review any ecological elements that require retention or protection.						
LE 03: Minimising impact on existing site ecology	2	2%	1	1%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A suitably qualified ecologist will outline measures to enhance the site's ecological value.						
LE 04: Enhancing site ecology	2	2%	0	0%	1	1%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: A Suitably Qualified Ecologist (SQE) will advise on appropriate measures to enhance ecological value.						
LE 05: Long term impact on biodiversity	2	2%	0	0%	2	2%
Land Use and Ecology Totals	**10**	**10.00%**	**5**	**5.00%**	**3**	**3.00%**

Pollution	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Pol 01: Impact of refrigerants	3	2.31%	2	1.54%	1	0.77%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Refrigerants will comply with BS EN 378:2008 and have a GWP <10. Systems will have low refrigerant impacts and be fitted with leak detection.						
Pol 02: NOx emissions	3	2.31%	3	2.31%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The scheme will use plant with NOx emission levels of <40mg/kWh.						
Pol 03.1: Surface water run-off : Flood risk	2	1.54%	1	0.77%	1	0.77%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: The site will be assessed against flood risk and if found to be medium or high risk a flood risk assessment will be carried out.						
Pol 03.2: Surface water run-off : Surface water run-off	2	1.54%	1	0.77%	1	0.77%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: An appropriate consultant will be engaged to evaluate drainage measures are incorporated to minimise surface water run off from the scheme.						
Pol 03.3: Surface water run-off : Minimising water course pollution	1	0.77%	1	0.77%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: Assessment will be made of discharge to water courses.						
Pol 04: Reduction of night time light pollution	1	0.77%	1	0.77%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: An external lighting strategy will be drawn up to ensure minimisation of obtrusive light.will						
Pol 05: Reduction of noise pollution	1	0.77%	1	0.77%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: There are/will be no noise sensitive buildings within 800m of the existing scheme.						
Pollution Totals	**13**	**10.00%**	**10**	**7.69%**	**3**	**2.30%**

Innovation	**Available**		**Targeted**		**Potential**	
	Credits	**Percent**	**Credits**	**Percent**	**Credits**	**Percent**
Inn 01: Innovation	10	10%	0	0%	0	0%
Steve Bickell (Malcolm Hollis - Sustainability Consultant) on 8 Aug 2016: No innovation credits have been sought. However, several would be achievable if required including; Man 03, Man 05, Wat 01, Wst 01, 02.						
Man 03: Responsible construction practices	1	1%	0	0%	0	0%
Man 05: Aftercare	1	1%	0	0%	0	0%
Hea 01: Visual comfort	1	1%	0	0%	0	0%
Hea 02: Indoor air quality	2	2%	0	0%	0	0%
Ene 01: Reduction of energy use and carbon emissions	1	1%	0	0%	0	0%
Wat 01: Water consumption	1	1%	0	0%	0	0%

Mat 01: Life cycle impacts	1	1%	0	0%	0	0%
Mat 03: Responsible sourcing of materials	1	1%	0	0%	0	0%
Wst 01: Construction site waste management	1	1%	0	0%	0	0%
Wst 02: Recycled aggregates	1	1%	0	0%	0	0%
Wst 05: Adaptation to climate change	1	1%	0	0%	0	0%
Innovation Totals (Up to a maximum of 10 credits)	**10**	**10.00%**	**0**	**0.00%**	**0**	**0.00%**
Overall Totals	**138**	**110.00%**	**94**	**72.42%**	**23**	**18.86%**