Energy & Sustainability Statement

13 - 15 John's Mews
London
WC1N 2PA

11th July 2017

Prepared for:

JM13 LTD

eb7 Ltd, Studio 1B, 63 Webber Street, London, SE1 0QW I 020 7148 6290 I info@eb7.co.uk I www.eb7.co.uk

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1.0 The Site & Proposal

The proposed development is located at 13 - 15 John's Mews, London, WC1N 2PA.

The development site relates to two attached buildings (Nos.13 and 15 St John's Mews), 2 x two storey traditional mews buildings located on the western side of the mews and forming part of a terrace.

The proposals comprises of the part demolition, change of use and conversion from B1 garage/workshop/offices (B1) to create 4 x 2 bed flats (C3) with basement and mansard extensions.

1.1 Planning Context

The project sits within the London Borough of Camden (Camden) and specific planning guidance has been taken into account via a per-application consultation.

Specific advice was offered in response to the pre-application submission:-

Sustainability

Water and energy

London Plan policy 5.3 'Sustainable design and construction' removes requirements for the Code for Sustainable Homes but continues to require development to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation.

The Council will continue to require the submission of a Sustainability Statement with applications for new residential development demonstrating how the development mitigates against the causes of climate change and adapts to the effects of climate change in line with existing policies contained in Camden's Core Strategy CS13 Tackling climate change through promoting higher environmental standards and Development Policies document DP22 Sustainable design and construction. Proposals should demonstrate how sustainable design and construction principles, including the relevant measures as set out in DP22 page 104, have been incorporated into the design and proposed implementation.

New residential development will be required to demonstrate that the development is capable of achieving a maximum internal water use of 105 litres per person/day, with an additional 5 litres person/day for external water use.

The Council will continue to apply policies which require compliance with energy performance standards until the Planning and Energy Act 2008 has been amended (likely late 2016). The Code Level 4 equivalent in carbon dioxide emissions reduction below part L Building Regulations 2013 is 20%. New residential dwellings will be required to demonstrate how this has been met by following the energy hierarchy in an energy statement.

Please note that policy CS13 also requires that all developments (existing and new build) achieve a 20% reduction in on-site carbon dioxide emissions through renewable technologies, unless demonstrated that such provision is not feasible.

Based on this, a sustainability statement and water efficiency should be submitted with any future applications.

1.2 Current Planning Policy

Since the date of the pre-application advice the new Local Plan was adopted by Camden on 3rdJuly 2017 and has replaced the Core Strategy and Camden Development Policies documents as the basis for planning decisions and future development in the borough.

Therefore the key policies taken into account when compiling this report are:-

- London Plan Policy
- Camden Local Plan – 2017 – Chapter 8 (key policies reproduced below)
- Camden's CPG 3 Sustainability

Camden's Local Plan, Chapter 8 - Sustainability and Climate Change

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

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

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve “excellent” in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new development from 2019.

1.3 The London Plan

On 10 March 2015, the Mayor published (i.e. adopted) the Further Alterations to the London Plan (FALP). From this date, the FALP are operative as formal alterations to the London Plan (the Mayor’s spatial development strategy) and form part of the development plan for Greater London; further updates to The London Plan – not relevant to this report – were adopted in 2016

Chapter 5 deals with London’s Response to Climate Change and covers areas such as climate change - minimising energy; (see Policy 5.2 below), sustainable use of water, aggregates and other resources, reducing air and water pollution, managing flood risk and sustainable urban drainage systems, conserving and enhancing the natural environment and promoting sustainable waste behaviour.

Of particular significance is Policy 5.2 Minimising Carbon Dioxide Emissions, which requires:-

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

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

As part of this assessment, it must consider unregulated energy use not covered under the Building Regulations at each stage of the Energy Hierarchy i.e. cooking and appliances and use of equipment.

In March 2016, the Mayor’s office published “Energy Planning - Greater London Authority guidance on preparing energy assessments”

This document formally introduces the principle of zero carbon hoes from 1st October 2016 and confirmed that “the London Plan policy seeking ‘zero carbon’ homes remains in place and was not changed by the recent Minor Alterations to the London Plan.”

‘Zero carbon homes are defined as homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Accordingly, this report is guided by and reports against the above noted required standards, however, it should be noted that the project at 13-15 Johns Mews would not be considered major development.

2.0 Baseline Energy Results

In order to consider the project against the London Plan Energy Hierarchy, this report will first establish the "Baseline" energy consumption.

2.1 Dwelling created via change of use/conversion

The new dwellings created as part of the conversion/extension of the existing office building will be considered against the Building Regulations AD L1B; Accordingly, the energy requirements for space heating, water heating and ventilation for the dwellings within the existing structure have been calculated using the Standard Assessment Procedure 2012 (SAP) in line with Part L1B of the Building Regulations 2013 and the Domestic Heating Compliance Guide 2nd Edition.

The baseline building results have been calculated and are presented in Table 4 below. They have been compiled assuming basic compliance with the building regulations as set out below:-

Table 1 - AD L1B Elemental Standards

Element	AD L1B U -Value Standard
Retained Walls (where upgraded)	0.30
New Walls	0.28
Retained/New Roof - pitched	0.16
Retained/New Roof - flat	0.18
Floors	0.22
Windows	1.6
Doors	1.8
Air permeability	$15m^3/Hr/m^2$

The replacement of/new controlled services are governed by the Compliance Guides:-

Table 2 – AD L1B - Controlled services and fittings

Controlled Service	AD L1B Compliance Requirement
Mains Gas Boiler	86% Efficient
DHW	150l tank with 35mm Foam insulation
Controls	Programmer, Stat, TRVs & Interlock
Lighting	N/A

The baseline un-regulated energy uses for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = $E_A = 207.8 \times (TFA \times N)^{0.4714}$

Cooking = (119 + 24N)/TFA

N= no of occupant SAP table 1B

TFA – Total Floor Areas

The unregulated energy use per sqm is summarised in Table 3 below

Table 3 – Unregulated Energy Use

Unit	Unregulated Energy Use Kg/sqm
Flat 1	15.08
Flat 2	15.13
Flat 3	15.29
Flat 4	15.23

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Camden Local Plans policies: -

Table 4 – Baseline energy consumption and CO2 emissions

Unit	Baseline Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Flat 1	32.38	15.08	47.46	4617.80
Flat 2	34.29	15.13	49.42	4543.81
Flat 3	31.49	15.29	46.78	3567.81
Flat 4	27.49	15.23	42.72	3488.19
Total				16217.61

The baseline SAP DER outputs are attached at **Appendix A** confirming the above tabulated data.

3.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Section 5 of The London Plan requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimising associated carbon dioxide emissions.

This section sets out the measures included within the design of the proposed dwellings, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the proposed development after the energy efficiency measures have been included.

To achieve reductions in energy, demand the following measures have been included within the design and specification of the building:

3.1 Orientation & Passive Design

Local Plan policy requires "measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.."

The project is based upon a site with fixed southwest – northeast orientation due to its mid-terrace location.

The fenestration design is specific to meeting the design requirements of the building's contribution to the conservation area, so options for external shading are limited.

Accordingly, passive solar gain control is achieved via the use of a solar control glazing with a g-value at less than 0.45.

Advantage is taken of the north easterly aspect – not seen from the road, with larger areas of glazing incorporated to enhance internal daylight levels and reduce reliance on artificial lighting

All flats have a design which enables cross ventilation, enabling a purge ventilation rate at circa 3 air changes per hour - maximising passive cooling, with upper floor flats able to purge ventilate overnight.

3.2 Heating system

The primary heating system for the dwellings will consist of a high efficiency condensing gas boilers - this will in turn provide domestic heating and hot water via highly insulated low loss cylinders for DHW storage

- High efficiency gas boiler – (89.3% SEDBUK efficiency)
- Built-in flue gas heat recovery, improving combustion efficiency by up to 3%

To increase the efficiency in the use of the heating system, the following controls will be used in a 'boiler interlock' system to eliminate needless firing of the boiler.

- Time and temperature zone control
- Boiler fitted with delayed start thermostat

3.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated u values exceed the Building Regulations minima, with specific guidance taken from the design team, with the applicant seeking to go beyond the recommendation contained within Camden's CPG 3:

New basement wall constructions will aim to be achieving a u value of 0.18.

Existing walls will be internally lined to go beyond the requirements of AD L1B, achieving a u value of 0.25.

The mansard roof structures will meet a u-value of 0.12 for the roof and 0.15 for the walls.

The basement floors will be an insulated ground slab floor structure achieving u = 0.14.
Glazing

New glazing for windows, roof lights and doors have area weighted average U-Values of $1.4w/m^2$ K or better

3.4 Lighting and appliances

A 100% of internal light fittings will be dedicated low-energy/compact fluorescent fittings, with extensive use of LED lighting.

It is anticipated that under the principles of BREEAM and best practice sustainability, all of the electrical appliances will be provided as part of the finished dwelling; fridge/freezers A+ rated, Dishwasher and washing machines A rated and tumble dryer with a B rating.

In addition, again in line with BREEAM principles, any external lighting will be of the low energy type with consideration given to the design and location to reduce light pollution.

3.5 Energy efficiency results

The following table shows a comparison between the baseline scheme assessed under the SAP methodology based upon AD Part L1B minima and the scheme following the introduction of energy efficiency measures (not including energy from renewable sources).

Table 5 – Energy consumption and CO2 reductions

Unit	"Be lean" Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total "Be lean" emissions Kg/sqm	Total emissions Kg
Flat 1	26.28	15.08	41.36	4024.33
Flat 2	26.97	15.13	42.10	3870.81
Flat 3	22.26	15.29	37.55	2863.84
Flat 4	21.53	15.23	36.76	3001.55
Total				13760.54

The results show that, the new dwellings with the energy efficiency measures have achieved emissions reductions of 15.15% over the baseline model and clearly, the applicant has confirmed their commitment to go beyond the requirements of the minimum standards of the Building Regulations through the fabric first approach.

The SAP 2013 Dwelling Emission Rate outputs are attached at **Appendix B.**

4.0 Supplying Energy Efficiently

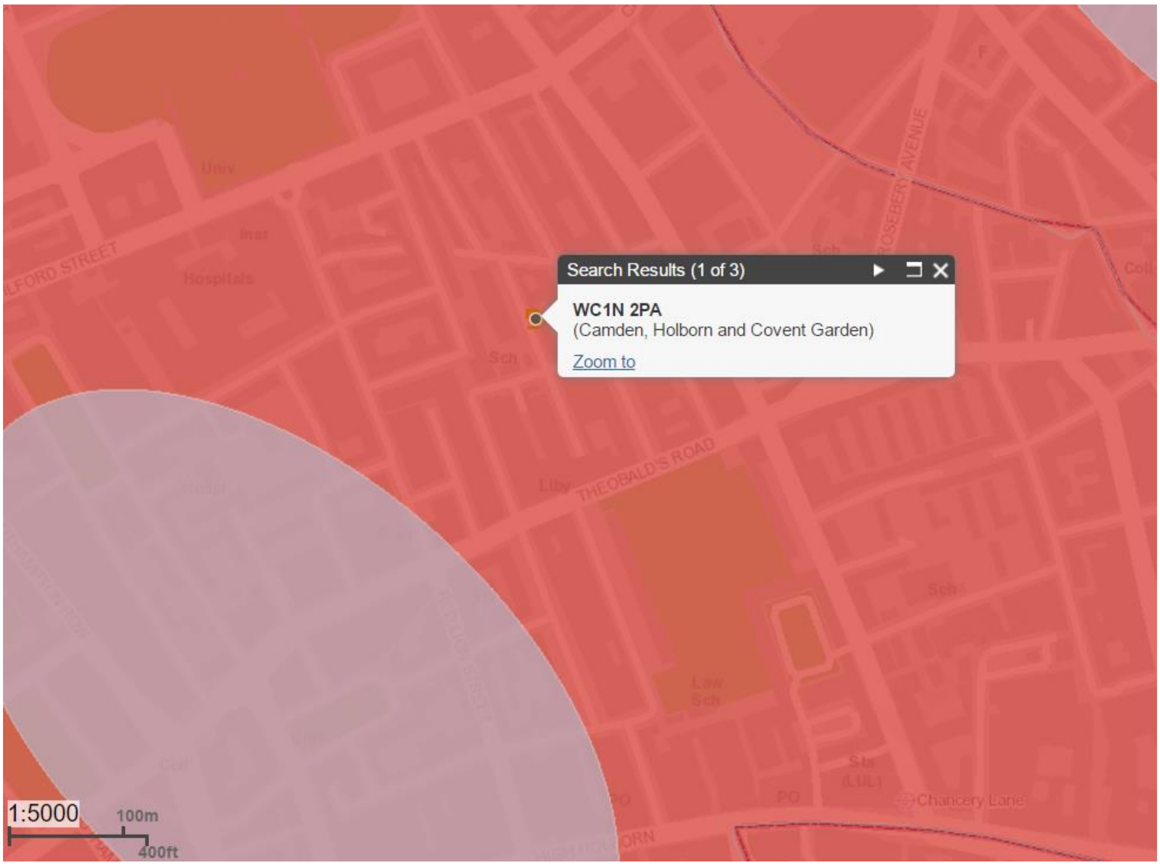
The second stage in the Mayor's 'Energy Hierarchy' is to ensure efficient and low carbon energy supply – Be Clean. In particular, this concerns provision of decentralised energy where practical and appropriate.

4.1 Community Heating/Combined Heat and Power (CHP)

Combined heat and power systems are essentially biomass or fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid. These systems can be employed on a large scale for community schemes or at the micro scale for individual dwellings.

Alternatively, larger scale systems operated as a standalone entity can be used to provide heat and power to the local neighbourhood – a District Energy Network (DEN).

The London Heat map has been consulted to look at the potential for the project to connect to a DEN now, or in the future. However, as can be seen from the extract below, the development site at Johns Mew's is some 150m distant from any opportunity areas of decentralised energy potential.



With this in mind, the distance that the heat network flow and return would need to be brought to site, as well as the small scale of the proposed development, the design team has agreed that a district heating system would not be appropriately employed in this scheme.

So, in line with best practice - we consider on-site provision:-

4.2 On-site CHP/District Heating

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand.

In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

Clearly, as a limited scale domestic development, with only the limited combined DHW demand to support a CHP installation, the economy of scale, in terms of year-round demand simply isn't present and as such the potential use of on-site CHP can be dismissed.

We should however, consider the use of a heat only DEN;

In more recent times, the difference between the actual and assumed efficiency of DH networks has come under the spotlight from a number of different sources.

Indeed, in recent studies collated by Innovate UK in the Building Data Exchange, inappropriately installed community heating systems were suffering heat losses of 50% or more.

However, when it comes to small scale networks as least, it is becoming very apparent that there is a difference between theoretical and real-world system efficiencies.
In the CIBSE Technical symposium "CHP and District Heating - how efficient are these technologies?" (2011), further commentary is made on this issue.

This report identifies and acknowledges that the heat losses within a well-designed DH network will be at minimum of 15%, so immediately it can be seen that, a large scale modular boiler system offering gross efficiencies at circa 96%, will be less efficient than a local condensing boiler with a gross efficiency of 92%-93% at point of delivery.

It should be noted, that the efficiency of the latest condensing boilers with built-in heat recovery systems and modern controls, such as the Vaillant Home boilers noted under 3.2 above, that they can achieve gross efficiencies close to 96%. A further significant benefit of the use of local gas boilers, is the lower NOx emission associated, commonly less than 40mg/KWh of heat delivered.

Clearly, a DH network driven by HOB would not be viable at the John's Mews development.

5.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, waves/tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The Energy Efficiency measures outlined under 3.0 above have the most significant impact on the heating and hot water energy requirements for the dwelling, and the associated reduction in gas consumption.

It should be noted that each Kwh of gas energy saved reduces emissions by 0.216kgCO_2/kwh, whereas, grid based electrical energy has a emissions factor of 0.519kgCO_2/kwh and accordingly, emphasis will be placed upon "off-setting" grid based electricity in order to achieve the optimum use of renewable technologies.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

5.1 Government incentives

5.1.1 Feed in Tariff

Feed in Tariffs (FiTs) replaced ROCs for renewable energy generators rated at less than 5MW in April 2010. FiTs are payments made for every kilowatt-hour kWh of renewable electricity generated and the level of the payment is laid down by the government, and varies for different renewable energy sources and at different scales. Unlike the flat rates paid for ROCs, FiTs are designed to compensate for less efficient/more expensive sources of renewable energy – and for the first time – make the investment in low and zero carbon technologies viable for both domestic generators and larger companies alike.

Recent reviews of Feed in Tariff rates will lead to lower returns on such technologies in 2016, but the expectation is that system capital costs and enhanced efficiencies will compensate for this over the medium term.

5.1.2 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally launched by the UK Government on 10th March 2011. The RHI will pay a tariff payment to renewable technologies that provide heat energy from a renewable source, with the payment relating to the KWh of heat energy provided e.g. if a property has a heat load of 20,000 KWh per annum, and it is 100% provided from a renewable source, then the tariff is paid against the 20,000KWh.

The Government decided on a two stage delivery - the first stage being for non-domestic schemes, which commenced in July 2011, with domestic scheme having come on stream in April 2014.

5.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontally axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded with other properties of 3-4 storeys in height adjacent and in all directions.

To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings.

It is clear that a wind turbine of this size would be considered unacceptable in this location and is therefore dismissed as an option.

5.3 Solar Energy

5.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Solar energy can be delivered in 2 formats as noted above, each system requiring an appropriate area in which to install panels.

The new development at John's Mews has some available roof space with a clear southerly aspect, so solar panels could be an option.

However, given the limited roof space available, and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and would offer a greater return in terms of carbon savings

Solar thermal systems also require a constant demand on hot water, and a large solar tank in which to store the pre-heated water as well as a management strategy to ensure energy savings and environmental benefits are maximised – the space required not being a commodity available for the development at John's Mews

Additionally, the development is located within the Bloomsbury conservation area, therefore the feasibility of installing solar thermal collectors is not considered viable due to the aesthetic constraints.

Accordingly, this technology is dismissed as being inappropriate for the development.

5.3.2 Photovoltaics (PV)

Solar panel electricity systems, also known as solar photovoltaics (PV), capture the sun's energy using photovoltaic cells. These cells will be accumulated on a PV panel, usually about 2.0m x 1.0m. These panels are then wall, roof or floor mounted and are connected directly to the electricity grid via the properties meter. In this way, the electrical generation can be fully exported and is not related to the consumption of the houses within this development.

PV panels also offer a much more attractive return from the Feed in Tariff often achieving 6-8% returns or better.

As noted above, the available roof spaces located on the main roof areas would be appropriate for solar PV panels. However, also as noted above, the development is located within the Bloomsbury conservation area where rooftop development is not acceptable. Therefore Photovoltaics are not proposed for inclusion.

5.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel. There also needs to be a local source of biomass fuel that can be delivered on a regular basis.

It is not considered appropriate to specify biomass boilers within these dwellings, as they do not have space to accommodate a relatively large biomass boiler and a supply of fuel.

A boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating, however, biomass releases high levels of NO_x emissions and would therefore have to be considered carefully against the high standard of air quality requirements set out in the London Plan.

5.5 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a ‘heat pump’. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by ‘condensing’ the heat taken from the ground, producing hot water temperatures in the region of 45^oC. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100 metre deep borehole will only provide about 5kW of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists don’t recommend using the structural boreholes.

Clearly, in the case of the proposed development at John’s Mews, there is no scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

5.6 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity and the associated emissions, so that the actual reduction in emissions can be limited. Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 90% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 10-20%. The table below demonstrates, on the assumption of a demand of 10000Kwh/year for heating and hot water:-

Table 6 – Comparative Heat Pump performance

Type of Array	Energy Consumption (Kwh/yr.)	Emission factor ($kgCO_2$/Kwh)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11111	0.216	2400
320% efficient ASHP	2813	0.519	1460
100% efficient immersion (back-up)	1000	0.519	519

A theoretical carbon saving of 17.5%

With the above data in mind, clearly an ASHP could be an option, however, heat pump would require external installation, giving rise to: -

- A potential visual impact to neighbouring properties overlooking the installation location.
- The requirement for a noise impact assessment, and the potential for a noise nuisance to be present in this dense suburban location.
- Associated loss of amenity space.
- Negative impact on the Bloomsbury conservation area.

Given such impacts, it is considered that air source heat pumps would not be appropriate at this location.

5.7 Final Emissions Calculation

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that, principally due to the development's location in the Bloomsbury conservation area – there are no suitable renewable technologies that would be acceptable in this location.

Accordingly, the data set out in Table 5 above and reproduced below demonstrate the final design SAP DER outputs, which are attached at **Appendix B**: -

Table 5 – Energy consumption and CO2 reductions

Unit	"Be lean" Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total "Be lean" emissions Kg/sqm	Total emissions Kg
Flat 1	26.28	15.08	41.36	4024.33
Flat 2	26.97	15.13	42.10	3870.81
Flat 3	22.26	15.29	37.55	2863.84
Flat 4	21.53	15.23	36.76	3001.55
Total				13760.54

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **15.15%** over and above the baseline model.

Excluding the un-regulated use, i.e. considering emissions controlled under the Building Regulations AD Part L, then the reduction equates to **22.44%** and given the proposals put in place above, it is clear that the applicant has sought to meet the requirements of London Borough of Camden's Policies through a careful design strategy involving best practice passive design and efficient services.

6.0 Sustainable Development

Due to the small scale nature of the development, LDF Policy DP22's requirement for a formal Eco Homes assessment does not apply - indeed, in March 2015, HM Government withdrew the Code for sustainable Homes and any other technical housing standard.

However, the applicant is committed to adopting many of the principles of Eco Homes and the Code for Sustainable Homes:-

Materials

- Newly construction elements will be considered against the BRE Green Guide to ensure that, where practical, the most environmentally friendly construction techniques are deployed.
- Construction materials will be sourced from suppliers capable of demonstrating a culture of responsible sourcing via environmental management certification, such as BES6001
- Insulation materials will be selected that demonstrate the use of blowing agents with a low global warming potential, specifically, a rating of 5 or less. Additionally, all insulants used will demonstrate responsible sourcing of material and key processes.
- The principle contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM requirements – this will include a pre-demolition audit to identify demolition materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site. The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.
- A Site Waste Management Plan (SWMP) will be developed prior to commencement of development stage to inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.
- The developer will also maximise the use of recycled and secondary aggregates.
- Waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Camden's collection policies.

Pollution

- The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.
- The completed dwellings will use low NOx emission gas boilers, with a minimum NOx rating of 5 and emissions at less than 40mg/Kwh
- The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.
- To void the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings. All new windows will be double glazed to minimise the transmission of noise between the building and adjacent properties.

Energy

- All the new dwellings will incorporate the energy efficient measures as set out within the main body of this report.
- Each home will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently.
- This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

- The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. In new homes, the applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with Level 4 of the Code for Sustainable Homes. A sample Part G internal water use calculation is attached at **Appendix D**
- The individual dwelling at basement level will have rainwater harvesting – water butts connected to rainwater pipes to enable the recycling of rainwater for the upkeep of terrace planting
- SuDs – The site is located in Flood Zone 1 – at low risk of flooding. The Site is also currently completely impermeable with hard landscaping and building areas, the main aim of development will be to improve the water retention of the site. The design will ensure the peak rate of surface runoff into watercourse is no worse than existing rate.
- Elements of green roof are to be incorporated into the design proposals to further aid in the attenuation of surface water run-off, as well as enhances site ecology.

7.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **16,218Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 3, the total amount of CO_2 emissions would be reduced to **13,761Kg/year**, a reduction of **15.15%.**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources, where practical and feasible. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, location and type of development suggest that given the limitations imposed by the sensitive location within the Bloomsbury conservation area, there are no appropriate renewable technologies that can be recommended for the Johns Mews development.

The SAP models (reproduced at **Appendix B**) for the development which have also been detailed above in Table 5, which show a final gross emission level of **13,760/year** representing a total reduction in emission over the baseline model, considering unregulated energy, of **15.15%.**

Tables 8 & 9 Demonstrate how the project at John's Mews aligns with the London Plan requirements and current GLA guidance on the preparation of energy statements.

Table 8 – Carbon Emission Reductions – Domestic Buildings

	Carbon Dioxide Emissions (Tonnes CO2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L1A Compliant Development	10.95	5.27
After Energy Demand Reduction	8.49	5.27
After renewable energy	8.49	5.27

Table 9 – Regulated Emissions Savings – Domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	2.46	22.47
Savings from renewable energy	0.00	0.00
Total Cumulative Savings	**2.46**	**22.47**
Annual Savings from off-set payment	**8.49**	
Cumulative savings for off-set payment	**254.7**	

Appendix A

Baseline Energy Use:-

SAP 2012 Dwelling Emission Rate Outputs

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 1 - Base

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	52.41	(1a)	x	2.95	(2a)	=	154.61	(3a)
First floor	44.88	(1b)	x	3.25	(2b)	=	145.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.47	(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) =	0.1	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.85	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.85	(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

DER WorkSheet: New dwelling design stage

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

1.08	1.06	1.04	0.93	0.91	0.81	0.81	0.79	0.85	0.91	0.96	1

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=	1.08	1.06	1.04	0.94	0.92	0.83	0.83	0.81	0.86	0.92	0.96	1	(24d)

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

(25)m=	1.08	1.06	1.04	0.94	0.92	0.83	0.83	0.81	0.86	0.92	0.96	1	(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			9.96	x1/[1/(1.6)+ 0.04]		=	14.98			(27)
Windows Type 2			21.89	x1/[1/(1.6)+ 0.04]		=	32.92			(27)
Rooflights			3.12	x1/[1/(1.6) + 0.04]		=	4.992			(27b)
Floor			52.41	x	0.22	=	11.5302			(28)
Walls Type1	45.39	0	45.39	x	0.28	=	12.71			(29)
Walls Type2	45.55	31.85	13.7	x	0.28	=	3.84			(29)
Walls Type3	21.89	1.89	20	x	0.25	=	5			(29)
Roof	12.53	3.12	9.41	x	0.18	=	1.69			(30)
Total area of elements, m²			177.77							(31)
Party wall			42.43	x	0	=	0			(32)
Party ceiling			39.88							(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) = 90.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12446.8 (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 | 26.67 | (36)

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

Total fabric heat loss (33) + (36) = | 117.04 | (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=	107.44	105.33	103.23	92.9	90.96	81.89	81.89	80.21	85.38	90.96	94.9	99.01	(38)

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

(39)m=	224.48	222.38	220.27	209.95	208	198.94	198.94	197.26	202.43	208	211.94	216.06

Average = Sum(39)1…12 /12= | 209.89 | (39)

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

(40)m=	2.31	2.29	2.26	2.16	2.14	2.04	2.04	2.03	2.08	2.14	2.18	2.22

Average = Sum(40)1…12 /12= | 2.16 | (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 | 2.71 | (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 | 98.63 | (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=	108.5	104.55	100.61	96.66	92.72	88.77	88.77	92.72	96.66	100.61	104.55	108.5

Total = Sum(44)1…12 = | 1183.6 | (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=	160.9	140.72	145.21	126.6	121.48	104.82	97.13	111.46	112.79	131.45	143.49	155.82

Total = Sum(45)1…12 = | 1551.89 | (45)

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

(46)m=	24.13	21.11	21.78	18.99	18.22	15.72	14.57	16.72	16.92	19.72	21.52	23.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 150 | (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) = | 150 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.01 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.93 | (52)

Temperature factor from Table 2b | 0.54 | (53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.67	(54)
Enter (50) or (54) in (55)		0.67	(55)

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

(56)m=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	205.04	180.59	189.35	169.32	165.62	147.54	141.28	155.6	155.51	175.59	186.21	199.96	(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)

Output from water heater

(64)m=	205.04	180.59	189.35	169.32	165.62	147.54	141.28	155.6	155.51	175.59	186.21	199.96

Output from water heater (annual)$_{1...12}$ 2071.61 (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=	88.81	78.69	83.6	76.27	75.7	69.03	67.61	72.37	71.68	79.02	81.88	87.12	(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=	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	(66)

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

(67)m=	28.07	24.93	20.27	15.35	11.47	9.69	10.47	13.6	18.26	23.19	27.06	28.85	(67)

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

(68)m=	251.87	254.48	247.9	233.88	216.18	199.54	188.43	185.82	192.4	206.42	224.12	240.76	(68)

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

(69)m=	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	(71)

Water heating gains (Table 5)

(72)m=	119.37	117.09	112.36	105.93	101.75	95.87	90.87	97.28	99.55	106.21	113.73	117.1	(72)

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

(73)m=	466	463.2	447.23	421.85	396.1	371.8	356.46	363.39	376.91	402.51	431.61	453.4	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.3	x	21.89	x	11.28	x	0.63	x	0.7	=	29.41	(75)
Northeast	0.9x	0.3	x	21.89	x	22.97	x	0.63	x	0.7	=	59.86	(75)
Northeast	0.9x	0.3	x	21.89	x	41.38	x	0.63	x	0.7	=	107.85	(75)
Northeast	0.9x	0.3	x	21.89	x	67.96	x	0.63	x	0.7	=	177.12	(75)
Northeast	0.9x	0.3	x	21.89	x	91.35	x	0.63	x	0.7	=	238.09	(75)
Northeast	0.9x	0.3	x	21.89	x	97.38	x	0.63	x	0.7	=	253.83	(75)
Northeast	0.9x	0.3	x	21.89	x	91.1	x	0.63	x	0.7	=	237.45	(75)
Northeast	0.9x	0.3	x	21.89	x	72.63	x	0.63	x	0.7	=	189.3	(75)
Northeast	0.9x	0.3	x	21.89	x	50.42	x	0.63	x	0.7	=	131.42	(75)
Northeast	0.9x	0.3	x	21.89	x	28.07	x	0.63	x	0.7	=	73.16	(75)
Northeast	0.9x	0.3	x	21.89	x	14.2	x	0.63	x	0.7	=	37	(75)
Northeast	0.9x	0.3	x	21.89	x	9.21	x	0.63	x	0.7	=	24.02	(75)
Southwest	0.9x	0.77	x	9.96	x	36.79		0.63	x	0.7	=	112	(79)
Southwest	0.9x	0.77	x	9.96	x	62.67		0.63	x	0.7	=	190.77	(79)
Southwest	0.9x	0.77	x	9.96	x	85.75		0.63	x	0.7	=	261.02	(79)
Southwest	0.9x	0.77	x	9.96	x	106.25		0.63	x	0.7	=	323.42	(79)
Southwest	0.9x	0.77	x	9.96	x	119.01		0.63	x	0.7	=	362.26	(79)
Southwest	0.9x	0.77	x	9.96	x	118.15		0.63	x	0.7	=	359.64	(79)
Southwest	0.9x	0.77	x	9.96	x	113.91		0.63	x	0.7	=	346.73	(79)
Southwest	0.9x	0.77	x	9.96	x	104.39		0.63	x	0.7	=	317.75	(79)
Southwest	0.9x	0.77	x	9.96	x	92.85		0.63	x	0.7	=	282.63	(79)
Southwest	0.9x	0.77	x	9.96	x	69.27		0.63	x	0.7	=	210.84	(79)
Southwest	0.9x	0.77	x	9.96	x	44.07		0.63	x	0.7	=	134.15	(79)
Southwest	0.9x	0.77	x	9.96	x	31.49		0.63	x	0.7	=	95.85	(79)
Rooflights	0.9x	1	x	3.12	x	26	x	0.63	x	0.8	=	36.8	(82)
Rooflights	0.9x	1	x	3.12	x	54	x	0.63	x	0.8	=	76.42	(82)
Rooflights	0.9x	1	x	3.12	x	96	x	0.63	x	0.8	=	135.86	(82)
Rooflights	0.9x	1	x	3.12	x	150	x	0.63	x	0.8	=	212.28	(82)
Rooflights	0.9x	1	x	3.12	x	192	x	0.63	x	0.8	=	271.72	(82)
Rooflights	0.9x	1	x	3.12	x	200	x	0.63	x	0.8	=	283.05	(82)
Rooflights	0.9x	1	x	3.12	x	189	x	0.63	x	0.8	=	267.48	(82)
Rooflights	0.9x	1	x	3.12	x	157	x	0.63	x	0.8	=	222.19	(82)
Rooflights	0.9x	1	x	3.12	x	115	x	0.63	x	0.8	=	162.75	(82)
Rooflights	0.9x	1	x	3.12	x	66	x	0.63	x	0.8	=	93.41	(82)
Rooflights	0.9x	1	x	3.12	x	33	x	0.63	x	0.8	=	46.7	(82)
Rooflights	0.9x	1	x	3.12	x	21	x	0.63	x	0.8	=	29.72	(82)

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

(83)m=	178.2	327.06	504.74	712.83	872.07	896.51	851.66	729.24	576.8	377.4	217.85	149.58	(83)

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

(84)m=	644.2	790.26	951.96	1134.68	1268.17	1268.31	1208.12	1092.64	953.71	779.92	649.46	602.98	(84)

DER WorkSheet: New dwelling design stage

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	0.99	0.98	0.95	0.89	0.77	0.63	0.69	0.88	0.97	0.99	1	(86)

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

(87)m=	18.52	18.76	19.19	19.81	20.34	20.75	20.91	20.87	20.54	19.85	19.13	18.55	(87)

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

(88)m=	19.14	19.15	19.16	19.23	19.24	19.3	19.3	19.32	19.28	19.24	19.22	19.19	(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.64	0.43	0.49	0.8	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=	16.99	17.24	17.67	18.32	18.82	19.2	19.29	19.29	19.04	18.38	17.65	17.06	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	17.64	17.89	18.32	18.96	19.47	19.86	19.98	19.96	19.68	19.01	18.28	17.7	(92)

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

(93)m=	17.64	17.89	18.32	18.96	19.47	19.86	19.98	19.96	19.68	19.01	18.28	17.7	(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	0.99	0.97	0.93	0.84	0.69	0.52	0.58	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	639.21	778.82	923.23	1054.13	1068.86	871.81	623.8	633.3	785.4	745.2	641.17	599.28	(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=	2995.45	2888.41	2602.69	2111.68	1616.29	1046.47	671.58	702.6	1129.94	1749.1	2369.7	2915.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1753.04	1417.64	1249.52	761.44	407.29	0	0	0	0	746.9	1244.55	1723.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 9303.85 (98)

Space heating requirement in kWh/m²/year 95.63 (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		86.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1753.04	1417.64	1249.52	761.44	407.29	0	0	0	0	746.9	1244.55	1723.48		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	2017.31	1631.35	1437.88	876.22	468.69	0	0	0	0	859.5	1432.16	1983.29		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													10706.39	(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)	205.04	180.59	189.35	169.32	165.62	147.54	141.28	155.6	155.51	175.59	186.21	199.96		
Efficiency of water heater													76.8	(216)
(217)m=	85.72	85.63	85.42	84.87	83.72	76.8	76.8	76.8	76.8	84.78	85.44	85.73		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	239.2	210.9	221.67	199.5	197.83	192.11	183.95	202.61	202.49	207.12	217.94	233.25		
Total = Sum(219a)$_{1...12}$ =													2508.58	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			10706.39	
Water heating fuel used			2508.58	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			495.69	(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	=	2312.58	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	541.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2854.43	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	257.26	(268)
Total CO2, kg/year			sum of (265)…(271) =		3150.62	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		32.38	(273)
EI rating (section 14)					70	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 2 - Base

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	52.41	(1a)	x	2.95	(2a)	=	154.61	(3a)
First floor	39.53	(1b)	x	3.25	(2b)	=	128.47	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.94	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	283.08	(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) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.86	(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

DER WorkSheet: New dwelling design stage

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

1.09	1.07	1.05	0.94	0.92	0.81	0.81	0.79	0.86	0.92	0.96	1.01

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=	1.09	1.07	1.05	0.94	0.92	0.83	0.83	0.81	0.87	0.92	0.96	1.01	(24d)

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

(25)m=	1.09	1.07	1.05	0.94	0.92	0.83	0.83	0.81	0.87	0.92	0.96	1.01	(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			7.24	x1/[1/(1.6)+ 0.04]		=	10.89			(27)
Windows Type 2			21.89	x1/[1/(1.6)+ 0.04]		=	32.92			(27)
Rooflights			3.12	x1/[1/(1.6) + 0.04]		=	4.992			(27b)
Floor			52.41	x	0.22	=	11.5302			(28)
Walls Type1	45.39	0	45.39	x	0.28	=	12.71			(29)
Walls Type2	42.3	29.13	13.17	x	0.28	=	3.69			(29)
Walls Type3	23.58	1.89	21.69	x	0.6	=	12.91			(29)
Roof	12.89	3.12	9.77	x	0.18	=	1.76			(30)
Total area of elements, m²			176.57							(31)
Party wall			42.43	x	0	=	0			(32)
Party ceiling			35.55							(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) = 94.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 12389.74 (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	26.49	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)		
Total fabric heat loss (33) + (36) =	120.6	(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=	101.95	99.95	97.95	88.12	86.26	77.59	77.59	75.99	80.93	86.26	90.02	93.96	(38)

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

(39)m=	222.55	220.56	218.56	208.72	206.86	198.2	198.2	196.59	201.53	206.86	210.62	214.56	

Average = Sum(39)$_{1\ldots12}$ /12= 208.65 (39)

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

(40)m=	2.42	2.4	2.38	2.27	2.25	2.16	2.16	2.14	2.19	2.25	2.29	2.33

Average = Sum(40)$_{1\ldots12}$ /12= 2.27 (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	2.65	(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	97.17	(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=	106.89	103	99.11	95.23	91.34	87.45	87.45	91.34	95.23	99.11	103	106.89	
									Total = Sum(44)$_{1\ldots12}$ =			1166.04	(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=	158.51	138.63	143.06	124.72	119.67	103.27	95.69	109.81	111.12	129.5	141.36	153.51	
									Total = Sum(45)$_{1\ldots12}$ =			1528.86	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	23.78	20.8	21.46	18.71	17.95	15.49	14.35	16.47	16.67	19.43	21.2	23.03	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(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) =	150	(50)
b) If manufacturer’s declared cylinder loss factor is not known:		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0.93	(52)
Temperature factor from Table 2b	0.54	(53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.67	(54)
Enter (50) or (54) in (55)		0.67	(55)

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

(56)m=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	202.65	178.5	187.2	167.44	163.81	145.99	139.83	153.95	153.84	173.64	184.08	197.65	(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)

Output from water heater

(64)m=	202.65	178.5	187.2	167.44	163.81	145.99	139.83	153.95	153.84	173.64	184.08	197.65	

Output from water heater (annual)$_{1...12}$ — 2048.58 (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=	88.02	77.99	82.88	75.64	75.1	68.51	67.13	71.82	71.12	78.37	81.18	86.35	(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=	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	27.04	24.01	19.53	14.78	11.05	9.33	10.08	13.1	17.59	22.33	26.07	27.79	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	242.6	245.12	238.78	225.27	208.22	192.2	181.49	178.98	185.32	198.83	215.87	231.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	(71)
Water heating gains (Table 5)													
(72)m=	118.3	116.06	111.4	105.06	100.95	95.15	90.23	96.54	98.78	105.34	112.74	116.07	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	453.71	450.96	435.47	410.88	385.99	362.45	347.58	354.39	367.46	392.27	420.45	441.52	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.3	x	21.89	x	11.28	x	0.63	x	0.7	=	29.41	(75)
Northeast 0.9x	0.3	x	21.89	x	22.97	x	0.63	x	0.7	=	59.86	(75)
Northeast 0.9x	0.3	x	21.89	x	41.38	x	0.63	x	0.7	=	107.85	(75)
Northeast 0.9x	0.3	x	21.89	x	67.96	x	0.63	x	0.7	=	177.12	(75)
Northeast 0.9x	0.3	x	21.89	x	91.35	x	0.63	x	0.7	=	238.09	(75)
Northeast 0.9x	0.3	x	21.89	x	97.38	x	0.63	x	0.7	=	253.83	(75)
Northeast 0.9x	0.3	x	21.89	x	91.1	x	0.63	x	0.7	=	237.45	(75)
Northeast 0.9x	0.3	x	21.89	x	72.63	x	0.63	x	0.7	=	189.3	(75)
Northeast 0.9x	0.3	x	21.89	x	50.42	x	0.63	x	0.7	=	131.42	(75)
Northeast 0.9x	0.3	x	21.89	x	28.07	x	0.63	x	0.7	=	73.16	(75)
Northeast 0.9x	0.3	x	21.89	x	14.2	x	0.63	x	0.7	=	37	(75)
Northeast 0.9x	0.3	x	21.89	x	9.21	x	0.63	x	0.7	=	24.02	(75)
Southwest 0.9x	0.77	x	7.24	x	36.79		0.63	x	0.7	=	81.41	(79)
Southwest 0.9x	0.77	x	7.24	x	62.67		0.63	x	0.7	=	138.67	(79)
Southwest 0.9x	0.77	x	7.24	x	85.75		0.63	x	0.7	=	189.74	(79)
Southwest 0.9x	0.77	x	7.24	x	106.25		0.63	x	0.7	=	235.1	(79)
Southwest 0.9x	0.77	x	7.24	x	119.01		0.63	x	0.7	=	263.33	(79)
Southwest 0.9x	0.77	x	7.24	x	118.15		0.63	x	0.7	=	261.42	(79)
Southwest 0.9x	0.77	x	7.24	x	113.91		0.63	x	0.7	=	252.04	(79)
Southwest 0.9x	0.77	x	7.24	x	104.39		0.63	x	0.7	=	230.98	(79)
Southwest 0.9x	0.77	x	7.24	x	92.85		0.63	x	0.7	=	205.45	(79)
Southwest 0.9x	0.77	x	7.24	x	69.27		0.63	x	0.7	=	153.26	(79)
Southwest 0.9x	0.77	x	7.24	x	44.07		0.63	x	0.7	=	97.51	(79)
Southwest 0.9x	0.77	x	7.24	x	31.49		0.63	x	0.7	=	69.67	(79)
Rooflights 0.9x	1	x	3.12	x	26	x	0.63	x	0.8	=	36.8	(82)
Rooflights 0.9x	1	x	3.12	x	54	x	0.63	x	0.8	=	76.42	(82)
Rooflights 0.9x	1	x	3.12	x	96	x	0.63	x	0.8	=	135.86	(82)
Rooflights 0.9x	1	x	3.12	x	150	x	0.63	x	0.8	=	212.28	(82)
Rooflights 0.9x	1	x	3.12	x	192	x	0.63	x	0.8	=	271.72	(82)
Rooflights 0.9x	1	x	3.12	x	200	x	0.63	x	0.8	=	283.05	(82)
Rooflights 0.9x	1	x	3.12	x	189	x	0.63	x	0.8	=	267.48	(82)
Rooflights 0.9x	1	x	3.12	x	157	x	0.63	x	0.8	=	222.19	(82)
Rooflights 0.9x	1	x	3.12	x	115	x	0.63	x	0.8	=	162.75	(82)
Rooflights 0.9x	1	x	3.12	x	66	x	0.63	x	0.8	=	93.41	(82)
Rooflights 0.9x	1	x	3.12	x	33	x	0.63	x	0.8	=	46.7	(82)
Rooflights 0.9x	1	x	3.12	x	21	x	0.63	x	0.8	=	29.72	(82)

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

(83)m=	147.62	274.96	433.45	624.5	773.14	798.3	756.97	642.47	499.62	319.82	181.22	123.41	(83)

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

(84)m=	601.33	725.92	868.92	1035.39	1159.13	1160.75	1104.54	996.86	867.08	712.09	601.67	564.93	(84)

DER WorkSheet: New dwelling design stage

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	0.99	0.98	0.96	0.9	0.79	0.66	0.72	0.9	0.98	0.99	1	(86)

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

(87)m=	18.41	18.64	19.07	19.7	20.25	20.7	20.88	20.84	20.48	19.76	19.03	18.44	(87)

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

(88)m=	19.07	19.08	19.09	19.16	19.17	19.23	19.23	19.24	19.21	19.17	19.15	19.12	(88)

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

(89)m=	0.99	0.99	0.98	0.94	0.85	0.66	0.45	0.52	0.82	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=	16.84	17.08	17.5	18.17	18.69	19.1	19.21	19.21	18.93	18.25	17.5	16.9	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

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

(92)m=	17.49	17.72	18.15	18.8	19.34	19.76	19.9	19.88	19.57	18.87	18.13	17.54	(92)

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

(93)m=	17.49	17.72	18.15	18.8	19.34	19.76	19.9	19.88	19.57	18.87	18.13	17.54	(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	0.99	0.97	0.93	0.86	0.71	0.54	0.6	0.84	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	596.59	715.83	844.5	968	991.69	822.91	595.71	601.61	727.27	682.75	594.11	561.34	(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=	2934.74	2827.91	2545.85	2066.21	1579.73	1022.84	653.36	683.87	1102.05	1710.77	2323.72	2861.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1739.58	1419.32	1265.8	790.71	437.5	0	0	0	0	764.84	1245.32	1711.45	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 9374.53 | (98)

Space heating requirement in kWh/m²/year | 101.96 | (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		86.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1739.58	1419.32	1265.8	790.71	437.5	0	0	0	0	764.84	1245.32	1711.45		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	2001.82	1633.28	1456.62	909.91	503.45	0	0	0	0	880.14	1433.04	1969.45		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													10787.72	(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)														
	202.65	178.5	187.2	167.44	163.81	145.99	139.83	153.95	153.84	173.64	184.08	197.65		
Efficiency of water heater													76.8	(216)
(217)m=	85.72	85.64	85.45	84.95	83.89	76.8	76.8	76.8	76.8	84.84	85.45	85.73		(217)
Fuel for water heating, kWh/month														
(219)m = (64)m x 100 ÷ (217)m														
(219)m=	236.4	208.43	219.07	197.11	195.26	190.09	182.08	200.46	200.31	204.68	215.41	230.54		
Total = Sum(219a)$_{1...12}$ =													2479.83	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			10787.72	
Water heating fuel used			2479.83	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			477.45	(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	=	2330.15	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	535.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2865.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	247.8	(268)
Total CO2, kg/year		sum of (265)…(271) =		3152.51	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		34.29	(273)
EI rating (section 14)				69	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 3 - Base

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.27	(1a) x	2.35	(2a) =	179.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.27	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	179.23	(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) =	0.17	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.92	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.92	(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

1.17	1.15	1.12	1.01	0.99	0.87	0.87	0.85	0.92	0.99	1.03	1.08

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=	1.17	1.15	1.12	1.01	0.99	0.88	0.88	0.86	0.92	0.99	1.03	1.08	(24d)

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

(25)m=	1.17	1.15	1.12	1.01	0.99	0.88	0.88	0.86	0.92	0.99	1.03	1.08	(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			8.14	x1/[1/(3.1)+ 0.04]		=	22.45			(27)
Windows Type 2			12.82	x1/[1/(3.1)+ 0.04]		=	35.36			(27)
Floor			5.62	x	0.22	=	1.2364			(28)
Walls Type1	49.96	20.96	29	x	0.3	=	8.7			(29)
Walls Type2	24.47	1.89	22.58	x	0.25	=	5.64			(29)
Roof	13.31	0	13.31	x	0.18	=	2.4			(30)
Total area of elements, m²			93.36							(31)
Party wall			51.46	x	0	=	0			(32)
Party floor			70.66							(32a)
Party ceiling			62.97							(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) = 78.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10474.79 (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 14 (36)

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

Total fabric heat loss (33) + (36) = 92.81 (37)

DER WorkSheet: New dwelling design stage

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=	69.18	67.83	66.47	59.69	58.34	52.04	52.04	50.87	54.46	58.34	61.04	63.76	(38)

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

(39)m=	161.99	160.64	159.28	152.5	151.15	144.85	144.85	143.68	147.27	151.15	153.85	156.57	

Average = Sum(39)1…12 /12= 152.31 (39)

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

(40)m=	2.12	2.11	2.09	2	1.98	1.9	1.9	1.88	1.93	1.98	2.02	2.05

Average = Sum(40)1…12 /12= 2 (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 2.39 (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 90.92 (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=	100.01	96.38	92.74	89.1	85.47	81.83	81.83	85.47	89.1	92.74	96.38	100.01

Total = Sum(44)1…12 = 1091.06 (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=	148.32	129.72	133.86	116.7	111.98	96.63	89.54	102.75	103.98	121.17	132.27	143.64

Total = Sum(45)1…12 = 1430.55 (45)

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

(46)m=	22.25	19.46	20.08	17.51	16.8	14.49	13.43	15.41	15.6	18.18	19.84	21.55	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (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) = 150 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.67 (54)

Enter (50) or (54) in (55) 0.67 (55)

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

(56)m=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	192.46	169.59	178	159.42	156.12	139.35	133.68	146.89	146.69	165.31	174.99	187.78	(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)

Output from water heater

(64)m=	192.46	169.59	178	159.42	156.12	139.35	133.68	146.89	146.69	165.31	174.99	187.78

Output from water heater (annual)$_{1...12}$ — 1950.27 — (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=	84.63	75.03	79.82	72.98	72.55	66.3	65.08	69.48	68.75	75.6	78.15	83.07	(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=	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	(66)

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

(67)m=	23.57	20.93	17.02	12.89	9.63	8.13	8.79	11.42	15.33	19.47	22.72	24.22	(67)

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

(68)m=	211.47	213.66	208.13	196.36	181.5	167.53	158.2	156.01	161.54	173.31	188.17	202.14	(68)

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

(69)m=	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	(71)

Water heating gains (Table 5)

(72)m=	113.75	111.65	107.29	101.36	97.51	92.09	87.48	93.38	95.48	101.62	108.55	111.66	(72)

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

(73)m=	410.61	408.07	394.27	372.43	350.47	329.58	316.3	322.64	334.17	356.22	381.26	399.84	(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)

Northeast 0.9x	0.77	x	12.82	x	11.28	x	0.63	x	0.7	=	44.21	(75)
Northeast 0.9x	0.77	x	12.82	x	22.97	x	0.63	x	0.7	=	89.98	(75)
Northeast 0.9x	0.77	x	12.82	x	41.38	x	0.63	x	0.7	=	162.12	(75)
Northeast 0.9x	0.77	x	12.82	x	67.96	x	0.63	x	0.7	=	266.25	(75)
Northeast 0.9x	0.77	x	12.82	x	91.35	x	0.63	x	0.7	=	357.89	(75)
Northeast 0.9x	0.77	x	12.82	x	97.38	x	0.63	x	0.7	=	381.55	(75)
Northeast 0.9x	0.77	x	12.82	x	91.1	x	0.63	x	0.7	=	356.93	(75)
Northeast 0.9x	0.77	x	12.82	x	72.63	x	0.63	x	0.7	=	284.55	(75)
Northeast 0.9x	0.77	x	12.82	x	50.42	x	0.63	x	0.7	=	197.55	(75)
Northeast 0.9x	0.77	x	12.82	x	28.07	x	0.63	x	0.7	=	109.97	(75)
Northeast 0.9x	0.77	x	12.82	x	14.2	x	0.63	x	0.7	=	55.62	(75)
Northeast 0.9x	0.77	x	12.82	x	9.21	x	0.63	x	0.7	=	36.1	(75)
Southwest 0.9x	0.77	x	8.14	x	36.79		0.63	x	0.7	=	91.53	(79)
Southwest 0.9x	0.77	x	8.14	x	62.67		0.63	x	0.7	=	155.91	(79)
Southwest 0.9x	0.77	x	8.14	x	85.75		0.63	x	0.7	=	213.33	(79)
Southwest 0.9x	0.77	x	8.14	x	106.25		0.63	x	0.7	=	264.32	(79)
Southwest 0.9x	0.77	x	8.14	x	119.01		0.63	x	0.7	=	296.06	(79)
Southwest 0.9x	0.77	x	8.14	x	118.15		0.63	x	0.7	=	293.92	(79)
Southwest 0.9x	0.77	x	8.14	x	113.91		0.63	x	0.7	=	283.37	(79)
Southwest 0.9x	0.77	x	8.14	x	104.39		0.63	x	0.7	=	259.69	(79)
Southwest 0.9x	0.77	x	8.14	x	92.85		0.63	x	0.7	=	230.99	(79)
Southwest 0.9x	0.77	x	8.14	x	69.27		0.63	x	0.7	=	172.32	(79)
Southwest 0.9x	0.77	x	8.14	x	44.07		0.63	x	0.7	=	109.63	(79)
Southwest 0.9x	0.77	x	8.14	x	31.49		0.63	x	0.7	=	78.33	(79)

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

(83)m=	135.74	245.89	375.45	530.57	653.95	675.47	640.3	544.24	428.53	282.28	165.26	114.43	(83)

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

(84)m=	546.34	653.96	769.71	903	1004.42	1005.05	956.6	866.88	762.71	638.5	546.52	514.27	(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	0.99	0.98	0.95	0.88	0.74	0.6	0.66	0.87	0.97	0.99	1	(86)

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

(87)m=	18.74	18.97	19.36	19.95	20.44	20.8	20.93	20.9	20.62	19.98	19.3	18.76	(87)

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

(88)m=	19.25	19.26	19.28	19.33	19.35	19.4	19.4	19.41	19.38	19.35	19.32	19.3	(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.62	0.41	0.48	0.78	0.95	0.99	0.99	(89)

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

(90)m=	17.29	17.52	17.92	18.53	18.99	19.32	19.39	19.39	19.18	18.58	17.9	17.34		(90)
										fLA = Living area ÷ (4) =			0.48	(91)

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

(92)m=	17.99	18.22	18.62	19.22	19.69	20.04	20.13	20.12	19.88	19.26	18.58	18.03	(92)

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

(93)m=	17.99	18.22	18.62	19.22	19.69	20.04	20.13	20.12	19.88	19.26	18.58	18.03	(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	0.97	0.93	0.83	0.67	0.5	0.57	0.81	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	541.54	643.64	745.17	835.81	838.38	676.15	482.4	491.22	619.99	607.28	538.55	510.62	(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=	2217.57	2139.78	1930.5	1573.12	1207.99	787.68	512	534.87	850.88	1308.8	1765.71	2164.82	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1246.96	1005.41	881.88	530.86	274.99	0	0	0	0	521.93	883.55	1230.73	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6576.31 (98)

Space heating requirement in kWh/m²/year 86.22 (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		86.9	(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)													
	1246.96	1005.41	881.88	530.86	274.99	0	0	0	0	521.93	883.55	1230.73	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1434.94	1156.97	1014.82	610.89	316.45	0	0	0	0	600.61	1016.75	1416.25	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 7567.68 (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)

192.46	169.59	178	159.42	156.12	139.35	133.68	146.89	146.69	165.31	174.99	187.78

Efficiency of water heater 76.8 (216)

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(217)m=	85.4	85.28	85.02	84.34	82.95	76.8	76.8	76.8	76.8	84.24	85.05	85.41	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	225.37	198.86	209.36	189.02	188.21	181.44	174.06	191.26	191.01	196.25	205.74	219.85	

Total = $Sum(219a)_{1...12}$ = 2370.43 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			7567.68	
Water heating fuel used			2370.43	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			416.18	(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	=	1634.62	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	512.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2146.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	216	(268)
Total CO2, kg/year		sum of (265)…(271) =		2401.55	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		31.49	(273)
EI rating (section 14)				73	(274)

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User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 4 - Base

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	5.28	(1a)	x	2.55	(2a)	=	13.46	(3a)
First floor	76.37	(1b)	x	2.1	(2b)	=	160.38	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	173.84	(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) =	0.17	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.92	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.92	(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

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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

1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.85	0.92	0.99	1.04	1.08

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=	1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.86	0.93	0.99	1.04	1.08	(24d)

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

(25)m=	1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.86	0.93	0.99	1.04	1.08	(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			5.92	x1/[1/(1.6)+ 0.04]		=	8.9			(27)
Windows Type 2			5.92	x1/[1/(1.6)+ 0.04]		=	8.9			(27)
Rooflights			4.3	x1/[1/(1.6) + 0.04]		=	6.880001			(27b)
Floor			9.73	x	0.22	=	2.1406			(28)
Walls Type1	36.78	0	36.78	x	0.28	=	10.3			(29)
Walls Type2	8.55	1.89	6.66	x	0.25	=	1.66			(29)
Walls Type3	56.27	11.84	44.43	x	0.28	=	12.44			(29)
Roof	46.19	4.3	41.89	x	0.18	=	7.54			(30)
Total area of elements, m²			157.52							(31)
Party wall			38.99	x	0	=	0			(32)
Party floor			71.82							(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) = 61.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7839.35 (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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 23.63 | (36)

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

Total fabric heat loss (33) + (36) = | 85.01 | (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=	67.48	66.16	64.83	58.22	56.9	50.72	50.72	49.57	53.1	56.9	59.54	62.19	(38)

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

(39)m=	152.49	151.16	149.84	143.22	141.9	135.72	135.72	134.58	138.1	141.9	144.55	147.19	

Average = $Sum(39)_{1...12}$ /12= | 143.03 | (39)

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

(40)m=	1.87	1.85	1.84	1.75	1.74	1.66	1.66	1.65	1.69	1.74	1.77	1.8	

Average = $Sum(40)_{1...12}$ /12= | 1.75 | (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 | 2.49 | (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 | 93.42 | (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=	102.76	99.02	95.29	91.55	87.81	84.08	84.08	87.81	91.55	95.29	99.02	102.76

Total = $Sum(44)_{1...12}$ = | 1121.03 | (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=	152.39	133.28	137.54	119.91	115.05	99.28	92	105.57	106.83	124.5	135.9	147.58

Total = $Sum(45)_{1...12}$ = | 1469.84 | (45)

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

(46)m=	22.86	19.99	20.63	17.99	17.26	14.89	13.8	15.84	16.02	18.68	20.39	22.14	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 150 | (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) = | 150 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.01 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0.93 | (52)

Temperature factor from Table 2b | 0.54 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.67	(54)
Enter (50) or (54) in (55)		0.67	(55)

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

(56)m=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	20.88	18.86	20.88	20.2	20.88	20.2	20.88	20.88	20.2	20.88	20.2	20.88	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	196.53	173.15	181.68	162.62	159.19	142	136.14	149.71	149.55	168.64	178.62	191.72	(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)

Output from water heater

(64)m=	196.53	173.15	181.68	162.62	159.19	142	136.14	149.71	149.55	168.64	178.62	191.72

Output from water heater (annual)$_{1...12}$ — 1989.56 (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=	85.98	76.21	81.04	74.04	73.57	67.18	65.9	70.41	69.7	76.71	79.36	84.38	(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=	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.85	22.07	17.95	13.59	10.16	8.58	9.27	12.05	16.17	20.53	23.96	25.54	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	222.85	225.17	219.34	206.93	191.27	176.55	166.72	164.41	170.24	182.64	198.3	213.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	(71)
Water heating gains (Table 5)													
(72)m=	115.57	113.41	108.93	102.84	98.88	93.31	88.58	94.64	96.8	103.1	110.22	113.42	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	426.68	424.05	409.62	386.76	363.72	341.85	327.97	334.5	346.61	369.68	395.89	415.39	(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)	
Northeast 0.9x	0.77	x	5.92	x	11.28	x	0.63	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	5.92	x	22.97	x	0.63	x	0.7	=	41.55	(75)
Northeast 0.9x	0.77	x	5.92	x	41.38	x	0.63	x	0.7	=	74.86	(75)
Northeast 0.9x	0.77	x	5.92	x	67.96	x	0.63	x	0.7	=	122.95	(75)
Northeast 0.9x	0.77	x	5.92	x	91.35	x	0.63	x	0.7	=	165.27	(75)
Northeast 0.9x	0.77	x	5.92	x	97.38	x	0.63	x	0.7	=	176.19	(75)
Northeast 0.9x	0.77	x	5.92	x	91.1	x	0.63	x	0.7	=	164.82	(75)
Northeast 0.9x	0.77	x	5.92	x	72.63	x	0.63	x	0.7	=	131.4	(75)
Northeast 0.9x	0.77	x	5.92	x	50.42	x	0.63	x	0.7	=	91.22	(75)
Northeast 0.9x	0.77	x	5.92	x	28.07	x	0.63	x	0.7	=	50.78	(75)
Northeast 0.9x	0.77	x	5.92	x	14.2	x	0.63	x	0.7	=	25.69	(75)
Northeast 0.9x	0.77	x	5.92	x	9.21	x	0.63	x	0.7	=	16.67	(75)
Southwest 0.9x	0.77	x	5.92	x	36.79		0.63	x	0.7	=	66.57	(79)
Southwest 0.9x	0.77	x	5.92	x	62.67		0.63	x	0.7	=	113.39	(79)
Southwest 0.9x	0.77	x	5.92	x	85.75		0.63	x	0.7	=	155.15	(79)
Southwest 0.9x	0.77	x	5.92	x	106.25		0.63	x	0.7	=	192.23	(79)
Southwest 0.9x	0.77	x	5.92	x	119.01		0.63	x	0.7	=	215.32	(79)
Southwest 0.9x	0.77	x	5.92	x	118.15		0.63	x	0.7	=	213.76	(79)
Southwest 0.9x	0.77	x	5.92	x	113.91		0.63	x	0.7	=	206.09	(79)
Southwest 0.9x	0.77	x	5.92	x	104.39		0.63	x	0.7	=	188.87	(79)
Southwest 0.9x	0.77	x	5.92	x	92.85		0.63	x	0.7	=	167.99	(79)
Southwest 0.9x	0.77	x	5.92	x	69.27		0.63	x	0.7	=	125.32	(79)
Southwest 0.9x	0.77	x	5.92	x	44.07		0.63	x	0.7	=	79.73	(79)
Southwest 0.9x	0.77	x	5.92	x	31.49		0.63	x	0.7	=	56.97	(79)
Rooflights 0.9x	1	x	4.3	x	26	x	0.63	x	0.8	=	50.71	(82)
Rooflights 0.9x	1	x	4.3	x	54	x	0.63	x	0.8	=	105.33	(82)
Rooflights 0.9x	1	x	4.3	x	96	x	0.63	x	0.8	=	187.25	(82)
Rooflights 0.9x	1	x	4.3	x	150	x	0.63	x	0.8	=	292.57	(82)
Rooflights 0.9x	1	x	4.3	x	192	x	0.63	x	0.8	=	374.49	(82)
Rooflights 0.9x	1	x	4.3	x	200	x	0.63	x	0.8	=	390.1	(82)
Rooflights 0.9x	1	x	4.3	x	189	x	0.63	x	0.8	=	368.64	(82)
Rooflights 0.9x	1	x	4.3	x	157	x	0.63	x	0.8	=	306.23	(82)
Rooflights 0.9x	1	x	4.3	x	115	x	0.63	x	0.8	=	224.31	(82)
Rooflights 0.9x	1	x	4.3	x	66	x	0.63	x	0.8	=	128.73	(82)
Rooflights 0.9x	1	x	4.3	x	33	x	0.63	x	0.8	=	64.37	(82)
Rooflights 0.9x	1	x	4.3	x	21	x	0.63	x	0.8	=	40.96	(82)

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

(83)m=	137.69	260.27	417.26	607.75	755.08	780.05	739.55	626.49	483.52	304.83	169.78	114.6	(83)

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

(84)m=	564.37	684.32	826.88	994.52	1118.79	1121.89	1067.52	960.99	830.12	674.51	565.68	529.99	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (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	0.99	0.98	0.94	0.85	0.68	0.53	0.6	0.84	0.97	0.99	1	(86)

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

(87)m=	18.98	19.21	19.61	20.17	20.61	20.89	20.97	20.95	20.73	20.15	19.5	19	(87)

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

(88)m=	19.42	19.43	19.45	19.5	19.51	19.57	19.57	19.58	19.55	19.51	19.49	19.47	(88)

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

(89)m=	0.99	0.99	0.97	0.91	0.78	0.56	0.37	0.43	0.75	0.95	0.99	1	(89)

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

(90)m=	17.65	17.88	18.28	18.87	19.27	19.52	19.56	19.57	19.41	18.87	18.22	17.7	(90)

fLA = Living area ÷ (4) = | 0.37 | (91)

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

(92)m=	18.14	18.38	18.77	19.35	19.77	20.03	20.08	20.08	19.9	19.34	18.69	18.18	(92)

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

(93)m=	18.14	18.38	18.77	19.35	19.77	20.03	20.08	20.08	19.9	19.34	18.69	18.18	(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	0.99	0.97	0.91	0.79	0.6	0.43	0.49	0.77	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	560.16	674.27	798.89	905.88	888.93	677.43	460.38	475.18	643.02	639.43	558.24	526.87	(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=	2110.79	2036.96	1839.08	1497.16	1144.87	736.91	472.69	495.22	801.03	1240.29	1676.03	2058.16	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1153.67	915.73	773.9	425.72	190.42	0	0	0	0	447.04	804.81	1139.28	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 5850.57 | (98)

Space heating requirement in kWh/m²/year | 71.65 | (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		86.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1153.67	915.73	773.9	425.72	190.42	0	0	0	0	447.04	804.81	1139.28		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1327.59	1053.77	890.57	489.89	219.13	0	0	0	0	514.42	926.14	1311.02		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													6732.53	(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)														
	196.53	173.15	181.68	162.62	159.19	142	136.14	149.71	149.55	168.64	178.62	191.72		
Efficiency of water heater													76.8	(216)
(217)m=	85.27	85.12	84.78	83.85	81.99	76.8	76.8	76.8	76.8	83.88	84.87	85.28		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	230.49	203.42	214.29	193.94	194.16	184.89	177.27	194.94	194.72	201.06	210.46	224.8		
Total = Sum(219a)$_{1...12}$ =													2424.44	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6732.53	
Water heating fuel used			2424.44	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			438.92	(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	=	1454.23	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	523.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1977.91	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	227.8	(268)
Total CO2, kg/year			sum of (265)…(271) =		2244.63	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		27.49	(273)
El rating (section 14)					76	(274)

Appendix B

SAP 2012 Dwelling Emission Rate Outputs

"Be Lean"

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	52.41	(1a) x	2.95	(2a) =	154.61	(3a)
First floor	44.88	(1b) x	3.25	(2b) =	145.86	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.29	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	300.47	(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) =	0.1	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.85	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.85	(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

DER WorkSheet: New dwelling design stage

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

1.08	1.06	1.04	0.93	0.91	0.81	0.81	0.79	0.85	0.91	0.96	1

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=	1.08	1.06	1.04	0.94	0.92	0.83	0.83	0.81	0.86	0.92	0.96	1	(24d)

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

(25)m=	1.08	1.06	1.04	0.94	0.92	0.83	0.83	0.81	0.86	0.92	0.96	1	(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	1.4	=	2.646			(26)
Windows Type 1			9.96	x1/[1/(1.4)+ 0.04]		=	13.2			(27)
Windows Type 2			21.89	x1/[1/(1.4)+ 0.04]		=	29.02			(27)
Rooflights			3.12	x1/[1/(1.4) + 0.04]		=	4.368			(27b)
Floor			52.41	x	0.14	=	7.3374			(28)
Walls Type1	45.39	0	45.39	x	0.18	=	8.17			(29)
Walls Type2	45.55	31.85	13.7	x	0.22	=	3.01			(29)
Walls Type3	21.89	1.89	20	x	0.2	=	4.02			(29)
Roof	12.53	3.12	9.41	x	0.14	=	1.32			(30)
Total area of elements, m²			177.77							(31)
Party wall			42.43	x	0	=	0			(32)
Party ceiling			39.88							(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) =	72.87	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12446.8	(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 | 26.67 | (36)

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

Total fabric heat loss (33) + (36) = | 99.53 | (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=	107.44	105.33	103.23	92.9	90.96	81.89	81.89	80.21	85.38	90.96	94.9	99.01	(38)

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

(39)m=	206.97	204.86	202.76	192.44	190.49	181.42	181.42	179.75	184.92	190.49	194.43	198.54	

Average = Sum(39)1…12 /12= | 192.37 | (39)

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

(40)m=	2.13	2.11	2.08	1.98	1.96	1.86	1.86	1.85	1.9	1.96	2	2.04	

Average = Sum(40)1…12 /12= | 1.98 | (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 | 2.71 | (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 | 98.63 | (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=	108.5	104.55	100.61	96.66	92.72	88.77	88.77	92.72	96.66	100.61	104.55	108.5	

Total = Sum(44)1…12 = | 1183.6 | (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=	160.9	140.72	145.21	126.6	121.48	104.82	97.13	111.46	112.79	131.45	143.49	155.82	

Total = Sum(45)1…12 = | 1551.89 | (45)

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

(46)m=	24.13	21.11	21.78	18.99	18.22	15.72	14.57	16.72	16.92	19.72	21.52	23.37	(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)

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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=	12.79	11.53	12.72	12.23	12.58	12.1	12.46	12.54	12.17	12.66	12.32	12.77	(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=	173.69	152.25	157.93	138.83	134.05	116.93	109.6	124	124.97	144.11	155.81	168.59	(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)

Output from water heater

(64)m=	173.69	152.25	157.93	138.83	134.05	116.93	109.6	124	124.97	144.11	155.81	168.59	

Output from water heater (annual)1…12 — 1700.76 — (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=	56.7	49.67	51.46	45.15	43.53	37.88	35.41	40.2	40.55	46.87	50.79	55	(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=	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	135.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	22.45	19.94	16.22	12.28	9.18	7.75	8.37	10.88	14.61	18.55	21.65	23.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	251.87	254.48	247.9	233.88	216.18	199.54	188.43	185.82	192.4	206.42	224.12	240.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	36.56	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	-108.52	(71)
Water heating gains (Table 5)													
(72)m=	76.2	73.92	69.17	62.71	58.51	52.61	47.6	54.03	56.32	63	70.54	73.93	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	417.22	415.04	399.98	375.56	350.57	326.6	311.09	317.42	330.02	354.67	383.01	404.46	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.3	x	21.89	x	11.28	x	0.63	x	0.7	=	29.41	(75)
Northeast	0.9x	0.3	x	21.89	x	22.97	x	0.63	x	0.7	=	59.86	(75)
Northeast	0.9x	0.3	x	21.89	x	41.38	x	0.63	x	0.7	=	107.85	(75)
Northeast	0.9x	0.3	x	21.89	x	67.96	x	0.63	x	0.7	=	177.12	(75)
Northeast	0.9x	0.3	x	21.89	x	91.35	x	0.63	x	0.7	=	238.09	(75)
Northeast	0.9x	0.3	x	21.89	x	97.38	x	0.63	x	0.7	=	253.83	(75)
Northeast	0.9x	0.3	x	21.89	x	91.1	x	0.63	x	0.7	=	237.45	(75)
Northeast	0.9x	0.3	x	21.89	x	72.63	x	0.63	x	0.7	=	189.3	(75)
Northeast	0.9x	0.3	x	21.89	x	50.42	x	0.63	x	0.7	=	131.42	(75)
Northeast	0.9x	0.3	x	21.89	x	28.07	x	0.63	x	0.7	=	73.16	(75)
Northeast	0.9x	0.3	x	21.89	x	14.2	x	0.63	x	0.7	=	37	(75)
Northeast	0.9x	0.3	x	21.89	x	9.21	x	0.63	x	0.7	=	24.02	(75)
Southwest	0.9x	0.77	x	9.96	x	36.79		0.63	x	0.7	=	112	(79)
Southwest	0.9x	0.77	x	9.96	x	62.67		0.63	x	0.7	=	190.77	(79)
Southwest	0.9x	0.77	x	9.96	x	85.75		0.63	x	0.7	=	261.02	(79)
Southwest	0.9x	0.77	x	9.96	x	106.25		0.63	x	0.7	=	323.42	(79)
Southwest	0.9x	0.77	x	9.96	x	119.01		0.63	x	0.7	=	362.26	(79)
Southwest	0.9x	0.77	x	9.96	x	118.15		0.63	x	0.7	=	359.64	(79)
Southwest	0.9x	0.77	x	9.96	x	113.91		0.63	x	0.7	=	346.73	(79)
Southwest	0.9x	0.77	x	9.96	x	104.39		0.63	x	0.7	=	317.75	(79)
Southwest	0.9x	0.77	x	9.96	x	92.85		0.63	x	0.7	=	282.63	(79)
Southwest	0.9x	0.77	x	9.96	x	69.27		0.63	x	0.7	=	210.84	(79)
Southwest	0.9x	0.77	x	9.96	x	44.07		0.63	x	0.7	=	134.15	(79)
Southwest	0.9x	0.77	x	9.96	x	31.49		0.63	x	0.7	=	95.85	(79)
Rooflights	0.9x	1	x	3.12	x	26	x	0.63	x	0.8	=	36.8	(82)
Rooflights	0.9x	1	x	3.12	x	54	x	0.63	x	0.8	=	76.42	(82)
Rooflights	0.9x	1	x	3.12	x	96	x	0.63	x	0.8	=	135.86	(82)
Rooflights	0.9x	1	x	3.12	x	150	x	0.63	x	0.8	=	212.28	(82)
Rooflights	0.9x	1	x	3.12	x	192	x	0.63	x	0.8	=	271.72	(82)
Rooflights	0.9x	1	x	3.12	x	200	x	0.63	x	0.8	=	283.05	(82)
Rooflights	0.9x	1	x	3.12	x	189	x	0.63	x	0.8	=	267.48	(82)
Rooflights	0.9x	1	x	3.12	x	157	x	0.63	x	0.8	=	222.19	(82)
Rooflights	0.9x	1	x	3.12	x	115	x	0.63	x	0.8	=	162.75	(82)
Rooflights	0.9x	1	x	3.12	x	66	x	0.63	x	0.8	=	93.41	(82)
Rooflights	0.9x	1	x	3.12	x	33	x	0.63	x	0.8	=	46.7	(82)
Rooflights	0.9x	1	x	3.12	x	21	x	0.63	x	0.8	=	29.72	(82)

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

(83)m=	178.2	327.06	504.74	712.83	872.07	896.51	851.66	729.24	576.8	377.4	217.85	149.58	(83)

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

(84)m=	595.43	742.1	904.72	1088.39	1222.64	1223.11	1162.75	1046.66	906.82	732.07	600.86	554.04	(84)

DER WorkSheet: New dwelling design stage

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	0.99	0.98	0.96	0.89	0.76	0.62	0.68	0.89	0.98	0.99	1	(86)

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

(87)m=	18.65	18.89	19.31	19.92	20.42	20.8	20.93	20.9	20.6	19.94	19.24	18.69	(87)

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

(88)m=	19.25	19.26	19.28	19.35	19.36	19.43	19.43	19.44	19.4	19.36	19.33	19.31	(88)

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

(89)m=	1	0.99	0.98	0.94	0.83	0.63	0.43	0.49	0.8	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=	16.25	16.61	17.22	18.13	18.82	19.3	19.4	19.4	19.09	18.17	17.15	16.33	(90)

fLA = Living area ÷ (4) = | 0.43 | (91)

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

(92)m=	17.27	17.58	18.11	18.89	19.5	19.94	20.05	20.04	19.73	18.92	18.04	17.33	(92)

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

(93)m=	17.27	17.58	18.11	18.89	19.5	19.94	20.05	20.04	19.73	18.92	18.04	17.33	(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	0.99	0.97	0.93	0.84	0.68	0.51	0.57	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	591.54	732.41	878.66	1011.32	1026.62	830.64	590.77	600.58	747.98	701.78	594.32	551.28	(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=	2684.97	2597.78	2353.57	1922.93	1486.34	968.48	626.56	654.29	1041.29	1585.68	2127.25	2607.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1557.51	1253.53	1097.34	656.36	342.03	0	0	0	0	657.63	1103.71	1530.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 8198.12 | (98)

Space heating requirement in kWh/m²/year | 84.26 | (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		93.2	(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)	1557.51	1253.53	1097.34	656.36	342.03	0	0	0	0	657.63	1103.71	1530.03		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1671.15	1344.99	1177.4	704.25	366.98	0	0	0	0	705.61	1184.23	1641.66		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													8796.27	(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	kWh/year	
Output from water heater (calculated above)	173.69	152.25	157.93	138.83	134.05	116.93	109.6	124	124.97	144.11	155.81	168.59		
Efficiency of water heater													87.3	(216)
(217)m=	89.9	89.88	89.82	89.68	89.36	87.3	87.3	87.3	87.3	89.66	89.83	89.9		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	193.2	169.4	175.82	154.81	150.01	133.94	125.54	142.04	143.15	160.72	173.45	187.52		
Total = Sum(219a)$_{1...12}$ =													1909.6	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8796.27	
Water heating fuel used			1909.6	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			396.55	(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	=	1899.99	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	412.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2312.47	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	205.81	(268)
Total CO2, kg/year			sum of (265)…(271) =		2557.2	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		26.28	(273)
EI rating (section 14)					76	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	52.41	(1a) x	2.95	(2a) =	154.61	(3a)
First floor	39.53	(1b) x	3.25	(2b) =	128.47	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.94	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	283.08	(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) =	0.11	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.86	(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

DER WorkSheet: New dwelling design stage

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

1.09	1.07	1.05	0.94	0.92	0.81	0.81	0.79	0.86	0.92	0.96	1.01

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=	1.09	1.07	1.05	0.94	0.92	0.83	0.83	0.81	0.87	0.92	0.96	1.01	(24d)

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

(25)m=	1.09	1.07	1.05	0.94	0.92	0.83	0.83	0.81	0.87	0.92	0.96	1.01	(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	1.4	=	2.646			(26)
Windows Type 1			7.24	x1/[1/(1.4)+ 0.04]		=	9.6			(27)
Windows Type 2			21.89	x1/[1/(1.4)+ 0.04]		=	29.02			(27)
Rooflights			3.12	x1/[1/(1.4) + 0.04]		=	4.368			(27b)
Floor			52.41	x	0.14	=	7.3374			(28)
Walls Type1	45.39	0	45.39	x	0.18	=	8.17			(29)
Walls Type2	42.3	29.13	13.17	x	0.22	=	2.9			(29)
Walls Type3	23.58	1.89	21.69	x	0.2	=	4.36			(29)
Roof	12.89	3.12	9.77	x	0.14	=	1.37			(30)
Total area of elements, m²			176.57							(31)
Party wall			42.43	x	0	=	0			(32)
Party ceiling			35.55							(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) =	69.53	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12389.74	(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 | 26.49 | (36)

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

Total fabric heat loss (33) + (36) = | 96.02 | (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=	101.95	99.95	97.95	88.12	86.26	77.59	77.59	75.99	80.93	86.26	90.02	93.96	(38)

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

(39)m=	197.97	195.97	193.97	184.14	182.28	173.61	173.61	172.01	176.95	182.28	186.04	189.98

Average = Sum(39)1…12 /12= | 184.07 | (39)

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

(40)m=	2.15	2.13	2.11	2	1.98	1.89	1.89	1.87	1.92	1.98	2.02	2.07

Average = Sum(40)1…12 /12= | 2 | (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 | 2.65 | (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 | 97.17 | (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=	106.89	103	99.11	95.23	91.34	87.45	87.45	91.34	95.23	99.11	103	106.89

Total = Sum(44)1…12 = | 1166.04 | (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=	158.51	138.63	143.06	124.72	119.67	103.27	95.69	109.81	111.12	129.5	141.36	153.51

Total = Sum(45)1…12 = | 1528.86 | (45)

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

(46)m=	23.78	20.8	21.46	18.71	17.95	15.49	14.35	16.47	16.67	19.43	21.2	23.03	(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)

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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=	12.78	11.52	12.71	12.21	12.56	12.09	12.45	12.52	12.16	12.65	12.31	12.76	(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=	171.29	150.16	155.76	136.94	132.24	115.36	108.14	122.33	123.28	142.15	153.67	166.27	(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)

Output from water heater

(64)m=	171.29	150.16	155.76	136.94	132.24	115.36	108.14	122.33	123.28	142.15	153.67	166.27	

Output from water heater (annual)$_{1...12}$ | 1677.58 | (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=	55.9	48.98	50.74	44.52	42.93	37.36	34.93	39.64	39.99	46.22	50.08	54.23	(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=	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	132.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.63	19.21	15.62	11.83	8.84	7.46	8.07	10.48	14.07	17.87	20.85	22.23	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	242.6	245.12	238.78	225.27	208.22	192.2	181.49	178.98	185.32	198.83	215.87	231.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	36.26	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	-106.05	(71)
Water heating gains (Table 5)													
(72)m=	75.13	72.88	68.2	61.84	57.7	51.89	46.95	53.28	55.54	62.12	69.56	72.89	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	405.13	402.98	388.37	364.71	340.54	317.32	302.28	308.51	320.7	344.59	372.05	392.79	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.3	x	21.89	x	11.28	x	0.63	x	0.7	=	29.41	(75)
Northeast	0.9x	0.3	x	21.89	x	22.97	x	0.63	x	0.7	=	59.86	(75)
Northeast	0.9x	0.3	x	21.89	x	41.38	x	0.63	x	0.7	=	107.85	(75)
Northeast	0.9x	0.3	x	21.89	x	67.96	x	0.63	x	0.7	=	177.12	(75)
Northeast	0.9x	0.3	x	21.89	x	91.35	x	0.63	x	0.7	=	238.09	(75)
Northeast	0.9x	0.3	x	21.89	x	97.38	x	0.63	x	0.7	=	253.83	(75)
Northeast	0.9x	0.3	x	21.89	x	91.1	x	0.63	x	0.7	=	237.45	(75)
Northeast	0.9x	0.3	x	21.89	x	72.63	x	0.63	x	0.7	=	189.3	(75)
Northeast	0.9x	0.3	x	21.89	x	50.42	x	0.63	x	0.7	=	131.42	(75)
Northeast	0.9x	0.3	x	21.89	x	28.07	x	0.63	x	0.7	=	73.16	(75)
Northeast	0.9x	0.3	x	21.89	x	14.2	x	0.63	x	0.7	=	37	(75)
Northeast	0.9x	0.3	x	21.89	x	9.21	x	0.63	x	0.7	=	24.02	(75)
Southwest	0.9x	0.77	x	7.24	x	36.79		0.63	x	0.7	=	81.41	(79)
Southwest	0.9x	0.77	x	7.24	x	62.67		0.63	x	0.7	=	138.67	(79)
Southwest	0.9x	0.77	x	7.24	x	85.75		0.63	x	0.7	=	189.74	(79)
Southwest	0.9x	0.77	x	7.24	x	106.25		0.63	x	0.7	=	235.1	(79)
Southwest	0.9x	0.77	x	7.24	x	119.01		0.63	x	0.7	=	263.33	(79)
Southwest	0.9x	0.77	x	7.24	x	118.15		0.63	x	0.7	=	261.42	(79)
Southwest	0.9x	0.77	x	7.24	x	113.91		0.63	x	0.7	=	252.04	(79)
Southwest	0.9x	0.77	x	7.24	x	104.39		0.63	x	0.7	=	230.98	(79)
Southwest	0.9x	0.77	x	7.24	x	92.85		0.63	x	0.7	=	205.45	(79)
Southwest	0.9x	0.77	x	7.24	x	69.27		0.63	x	0.7	=	153.26	(79)
Southwest	0.9x	0.77	x	7.24	x	44.07		0.63	x	0.7	=	97.51	(79)
Southwest	0.9x	0.77	x	7.24	x	31.49		0.63	x	0.7	=	69.67	(79)
Rooflights	0.9x	1	x	3.12	x	26	x	0.63	x	0.8	=	36.8	(82)
Rooflights	0.9x	1	x	3.12	x	54	x	0.63	x	0.8	=	76.42	(82)
Rooflights	0.9x	1	x	3.12	x	96	x	0.63	x	0.8	=	135.86	(82)
Rooflights	0.9x	1	x	3.12	x	150	x	0.63	x	0.8	=	212.28	(82)
Rooflights	0.9x	1	x	3.12	x	192	x	0.63	x	0.8	=	271.72	(82)
Rooflights	0.9x	1	x	3.12	x	200	x	0.63	x	0.8	=	283.05	(82)
Rooflights	0.9x	1	x	3.12	x	189	x	0.63	x	0.8	=	267.48	(82)
Rooflights	0.9x	1	x	3.12	x	157	x	0.63	x	0.8	=	222.19	(82)
Rooflights	0.9x	1	x	3.12	x	115	x	0.63	x	0.8	=	162.75	(82)
Rooflights	0.9x	1	x	3.12	x	66	x	0.63	x	0.8	=	93.41	(82)
Rooflights	0.9x	1	x	3.12	x	33	x	0.63	x	0.8	=	46.7	(82)
Rooflights	0.9x	1	x	3.12	x	21	x	0.63	x	0.8	=	29.72	(82)

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

(83)m=	147.62	274.96	433.45	624.5	773.14	798.3	756.97	642.47	499.62	319.82	181.22	123.41	(83)

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

(84)m=	552.75	677.94	821.82	989.21	1113.68	1115.62	1059.25	950.98	820.32	664.41	553.27	516.2	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (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	0.99	0.99	0.96	0.9	0.77	0.64	0.7	0.9	0.98	1	1	(86)

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

(87)m=	18.62	18.85	19.26	19.87	20.38	20.78	20.92	20.89	20.57	19.9	19.21	18.66	(87)

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

(88)m=	19.23	19.25	19.26	19.33	19.34	19.41	19.41	19.42	19.38	19.34	19.32	19.29	(88)

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

(89)m=	1	0.99	0.98	0.94	0.85	0.65	0.44	0.51	0.82	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=	16.19	16.53	17.13	18.05	18.76	19.27	19.38	19.38	19.04	18.11	17.09	16.27	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

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

(92)m=	17.19	17.49	18.01	18.8	19.43	19.89	20.02	20	19.67	18.85	17.96	17.26	(92)

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

(93)m=	17.19	17.49	18.01	18.8	19.43	19.89	20.02	20	19.67	18.85	17.96	17.26	(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	0.99	0.97	0.93	0.85	0.69	0.52	0.59	0.84	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	549.25	669.73	800.17	924.86	947.02	775.19	554.98	562.3	687.51	639.32	547.57	513.67	(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=	2552.06	2466.62	2232.57	1823.15	1408.87	918.36	593.13	619.35	985.46	1502.95	2021.02	2480.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1490.09	1207.51	1065.7	646.77	343.62	0	0	0	0	642.54	1060.88	1463.11	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 7920.23 | (98)

Space heating requirement in kWh/m²/year | 86.15 | (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		93.2	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1490.09	1207.51	1065.7	646.77	343.62	0	0	0	0	642.54	1060.88	1463.11		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1598.81	1295.62	1143.46	693.95	368.69	0	0	0	0	689.42	1138.29	1569.86		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													8498.1	(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	kWh/year	
Output from water heater (calculated above)	171.29	150.16	155.76	136.94	132.24	115.36	108.14	122.33	123.28	142.15	153.67	166.27		
Efficiency of water heater													87.3	(216)
(217)m=	89.89	89.87	89.82	89.68	89.37	87.3	87.3	87.3	87.3	89.66	89.82	89.9		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	190.55	167.08	173.42	152.69	147.96	132.14	123.88	140.13	141.21	158.54	171.09	184.95		
Total = Sum(219a)$_{1...12}$ =													1883.64	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8498.1	
Water heating fuel used			1883.64	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			381.96	(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	=	1835.59	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	406.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2242.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	198.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		2479.62	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		26.97	(273)
EI rating (section 14)				76	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	76.27	(1a)	x	2.35	(2a)	=	179.23	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			179.23	(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) =	0.17	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.92	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.92	(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

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

1.17	1.15	1.12	1.01	0.99	0.87	0.87	0.85	0.92	0.99	1.03	1.08

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=	1.17	1.15	1.12	1.01	0.99	0.88	0.88	0.86	0.92	0.99	1.03	1.08	(24d)

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

(25)m=	1.17	1.15	1.12	1.01	0.99	0.88	0.88	0.86	0.92	0.99	1.03	1.08	(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	1.4	=	2.646			(26)
Windows Type 1			8.14	x1/[1/(1.4)+ 0.04]		=	10.79			(27)
Windows Type 2			12.82	x1/[1/(1.4)+ 0.04]		=	17			(27)
Floor			5.62	x	0.14	=	0.7868			(28)
Walls Type1	49.96	20.96	29	x	0.25	=	7.25			(29)
Walls Type2	24.47	1.89	22.58	x	0.2	=	4.54			(29)
Roof	13.31	0	13.31	x	0.14	=	1.86			(30)
Total area of elements, m²			93.36							(31)
Party wall			51.46	x	0	=	0			(32)
Party floor			70.66							(32a)
Party ceiling			62.97							(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) = 44.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10474.79 (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 14 (36)

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

Total fabric heat loss (33) + (36) = 58.88 (37)

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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=	69.18	67.83	66.47	59.69	58.34	52.04	52.04	50.87	54.46	58.34	61.04	63.76	(38)

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

(39)m=	128.06	126.7	125.35	118.56	117.21	110.91	110.91	109.75	113.34	117.21	119.92	122.63	

Average = Sum(39)$_{1\ldots12}$ /12= 118.38 (39)

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

(40)m=	1.68	1.66	1.64	1.55	1.54	1.45	1.45	1.44	1.49	1.54	1.57	1.61	

Average = Sum(40)$_{1\ldots12}$ /12= 1.55 (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 2.39 (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 90.92 (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=	100.01	96.38	92.74	89.1	85.47	81.83	81.83	85.47	89.1	92.74	96.38	100.01	

Total = Sum(44)$_{1\ldots12}$ = 1091.06 (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=	148.32	129.72	133.86	116.7	111.98	96.63	89.54	102.75	103.98	121.17	132.27	143.64	

Total = Sum(45)$_{1\ldots12}$ = 1430.55 (45)

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

(46)m=	22.25	19.46	20.08	17.51	16.8	14.49	13.43	15.41	15.6	18.18	19.84	21.55	(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)

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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=	12.73	11.46	12.63	12.15	12.5	12.04	12.4	12.47	12.1	12.58	12.25	12.71	(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=	161.05	141.18	146.49	128.85	124.48	108.67	101.94	115.22	116.08	133.75	144.52	156.35	(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)

Output from water heater

(64)m=	161.05	141.18	146.49	128.85	124.48	108.67	101.94	115.22	116.08	133.75	144.52	156.35

Output from water heater (annual)$_{1...12}$ — 1578.59 (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=	52.5	46	47.67	41.84	40.36	35.14	32.87	37.28	37.6	43.43	47.04	50.94	(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=	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	119.41	(66)

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

(67)m=	18.85	16.74	13.62	10.31	7.71	6.51	7.03	9.14	12.26	15.57	18.18	19.38	(67)

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

(68)m=	211.47	213.66	208.13	196.36	181.5	167.53	158.2	156.01	161.54	173.31	188.17	202.14	(68)

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

(69)m=	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	34.94	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	-95.53	(71)

Water heating gains (Table 5)

(72)m=	70.56	68.45	64.07	58.11	54.25	48.8	44.18	50.11	52.22	58.38	65.34	68.47	(72)

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

(73)m=	362.71	360.68	347.64	326.61	305.28	284.67	271.24	277.08	287.85	309.09	333.51	351.8	(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)

Northeast 0.9x	0.77	x	12.82	x	11.28	x	0.63	x	0.7	=	44.21	(75)
Northeast 0.9x	0.77	x	12.82	x	22.97	x	0.63	x	0.7	=	89.98	(75)
Northeast 0.9x	0.77	x	12.82	x	41.38	x	0.63	x	0.7	=	162.12	(75)
Northeast 0.9x	0.77	x	12.82	x	67.96	x	0.63	x	0.7	=	266.25	(75)
Northeast 0.9x	0.77	x	12.82	x	91.35	x	0.63	x	0.7	=	357.89	(75)
Northeast 0.9x	0.77	x	12.82	x	97.38	x	0.63	x	0.7	=	381.55	(75)
Northeast 0.9x	0.77	x	12.82	x	91.1	x	0.63	x	0.7	=	356.93	(75)
Northeast 0.9x	0.77	x	12.82	x	72.63	x	0.63	x	0.7	=	284.55	(75)
Northeast 0.9x	0.77	x	12.82	x	50.42	x	0.63	x	0.7	=	197.55	(75)
Northeast 0.9x	0.77	x	12.82	x	28.07	x	0.63	x	0.7	=	109.97	(75)
Northeast 0.9x	0.77	x	12.82	x	14.2	x	0.63	x	0.7	=	55.62	(75)
Northeast 0.9x	0.77	x	12.82	x	9.21	x	0.63	x	0.7	=	36.1	(75)
Southwest 0.9x	0.77	x	8.14	x	36.79		0.63	x	0.7	=	91.53	(79)
Southwest 0.9x	0.77	x	8.14	x	62.67		0.63	x	0.7	=	155.91	(79)
Southwest 0.9x	0.77	x	8.14	x	85.75		0.63	x	0.7	=	213.33	(79)
Southwest 0.9x	0.77	x	8.14	x	106.25		0.63	x	0.7	=	264.32	(79)
Southwest 0.9x	0.77	x	8.14	x	119.01		0.63	x	0.7	=	296.06	(79)
Southwest 0.9x	0.77	x	8.14	x	118.15		0.63	x	0.7	=	293.92	(79)
Southwest 0.9x	0.77	x	8.14	x	113.91		0.63	x	0.7	=	283.37	(79)
Southwest 0.9x	0.77	x	8.14	x	104.39		0.63	x	0.7	=	259.69	(79)
Southwest 0.9x	0.77	x	8.14	x	92.85		0.63	x	0.7	=	230.99	(79)
Southwest 0.9x	0.77	x	8.14	x	69.27		0.63	x	0.7	=	172.32	(79)
Southwest 0.9x	0.77	x	8.14	x	44.07		0.63	x	0.7	=	109.63	(79)
Southwest 0.9x	0.77	x	8.14	x	31.49		0.63	x	0.7	=	78.33	(79)

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

(83)m=	135.74	245.89	375.45	530.57	653.95	675.47	640.3	544.24	428.53	282.28	165.26	114.43	(83)

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

(84)m=	498.45	606.58	723.09	857.18	959.23	960.14	911.54	821.32	716.38	591.37	498.77	466.24	(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	0.99	0.98	0.94	0.85	0.67	0.52	0.58	0.84	0.97	0.99	1	(86)

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

(87)m=	19.16	19.38	19.75	20.28	20.68	20.92	20.98	20.97	20.79	20.26	19.66	19.19	(87)

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

(88)m=	19.56	19.57	19.58	19.65	19.66	19.72	19.72	19.73	19.7	19.66	19.63	19.61	(88)

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

(89)m=	1	0.99	0.97	0.92	0.79	0.56	0.38	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)

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(90)m=	17.16	17.49	18.03	18.83	19.36	19.67	19.72	19.72	19.54	18.82	17.94	17.24		(90)
										fLA = Living area ÷ (4) =			0.48	(91)

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

(92)m=	18.12	18.41	18.86	19.53	20	20.28	20.33	20.32	20.14	19.52	18.77	18.18	(92)

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

(93)m=	18.12	18.41	18.86	19.53	20	20.28	20.33	20.32	20.14	19.52	18.77	18.18	(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	0.99	0.97	0.92	0.81	0.61	0.44	0.51	0.79	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	495.38	598.81	701.52	787.91	773.3	587.99	404.99	416.8	563.07	563.65	493.26	464.06	(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=	1770.4	1711.29	1549.78	1260.85	973.03	629.83	413.4	430.75	684.85	1045.21	1400.06	1714.38	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	948.62	747.58	631.1	340.51	148.59	0	0	0	0	358.28	652.9	930.24	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4757.82 (98)

Space heating requirement in kWh/m²/year 62.38 (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		93.2	(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)

948.62	747.58	631.1	340.51	148.59	0	0	0	0	358.28	652.9	930.24

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

1017.83	802.13	677.15	365.36	159.43	0	0	0	0	384.42	700.53	998.11

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5104.96 (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)

161.05	141.18	146.49	128.85	124.48	108.67	101.94	115.22	116.08	133.75	144.52	156.35

Efficiency of water heater 87.3 (216)

(217)m=	89.77	89.73	89.64	89.38	88.85	87.3	87.3	87.3	87.3	89.39	89.66	89.77	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	179.41	157.35	163.42	144.15	140.1	124.48	116.78	131.98	132.96	149.62	161.19	174.17

Total = $Sum(219a)_{1...12}$ = 1775.6 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			5104.96	
Water heating fuel used			1775.6	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			332.94	(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	=	1102.67	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	383.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1486.2	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	172.8	(268)
Total CO2, kg/year			sum of (265)…(271) =		1697.92	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		22.26	(273)
El rating (section 14)					81	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	George Farr	**Stroma Number:**	STRO028460
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	5.28	(1a)	x	2.55	(2a)	=	13.46	(3a)
First floor	76.37	(1b)	x	2.1	(2b)	=	160.38	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	173.84	(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) =	0.17	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.92	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.92	(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

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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

1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.85	0.92	0.99	1.04	1.08

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=	1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.86	0.93	0.99	1.04	1.08	(24d)

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

(25)m=	1.18	1.15	1.13	1.01	0.99	0.88	0.88	0.86	0.93	0.99	1.04	1.08	(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	1.4	=	2.646			(26)
Windows Type 1			5.92	x1/[1/(1.4)+ 0.04]		=	7.85			(27)
Windows Type 2			5.92	x1/[1/(1.4)+ 0.04]		=	7.85			(27)
Rooflights			4.3	x1/[1/(1.4) + 0.04]		=	6.02			(27b)
Floor			9.73	x	0.14	=	1.3622			(28)
Walls Type1	36.78	0	36.78	x	0.15	=	5.52			(29)
Walls Type2	8.55	1.89	6.66	x	0.2	=	1.34			(29)
Walls Type3	56.27	11.84	44.43	x	0.15	=	6.66			(29)
Roof	46.19	4.3	41.89	x	0.14	=	5.86			(30)
Total area of elements, m²			157.52							(31)
Party wall			38.99	x	0	=	0			(32)
Party floor			71.82							(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) = 44.79 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7839.35 (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 | 23.63 | (36)

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

Total fabric heat loss (33) + (36) = | 68.42 | (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=	67.48	66.16	64.83	58.22	56.9	50.72	50.72	49.57	53.1	56.9	59.54	62.19	(38)

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

(39)m=	135.9	134.58	133.25	126.64	125.32	119.14	119.14	117.99	121.52	125.32	127.96	130.61	

Average = Sum(39)$_{1...12}$ /12= | 126.45 | (39)

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

(40)m=	1.66	1.65	1.63	1.55	1.53	1.46	1.46	1.45	1.49	1.53	1.57	1.6

Average = Sum(40)$_{1...12}$ /12= | 1.55 | (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 | 2.49 | (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 | 93.42 | (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=	102.76	99.02	95.29	91.55	87.81	84.08	84.08	87.81	91.55	95.29	99.02	102.76

Total = Sum(44)$_{1...12}$ = | 1121.03 | (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=	152.39	133.28	137.54	119.91	115.05	99.28	92	105.57	106.83	124.5	135.9	147.58

Total = Sum(45)$_{1...12}$ = | 1469.84 | (45)

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

(46)m=	22.86	19.99	20.63	17.99	17.26	14.89	13.8	15.84	16.02	18.68	20.39	22.14	(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)

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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=	12.75	11.49	12.66	12.18	12.53	12.06	12.42	12.49	12.12	12.6	12.28	12.73	(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=	165.14	144.78	150.19	132.08	127.58	111.34	104.42	118.06	118.95	137.11	148.19	160.31	(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)

Output from water heater

(64)m=	165.14	144.78	150.19	132.08	127.58	111.34	104.42	118.06	118.95	137.11	148.19	160.31	

Output from water heater (annual)$_{1...12}$ | 1618.16 | (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=	53.86	47.19	48.9	42.91	41.39	36.03	33.7	38.22	38.55	44.55	48.26	52.25	(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=	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	124.67	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.88	17.66	14.36	10.87	8.13	6.86	7.41	9.64	12.94	16.42	19.17	20.44	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	222.85	225.17	219.34	206.93	191.27	176.55	166.72	164.41	170.24	182.64	198.3	213.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	35.47	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	-99.74	(71)
Water heating gains (Table 5)													
(72)m=	72.39	70.22	65.72	59.6	55.63	50.04	45.29	51.38	53.54	59.88	67.03	70.23	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	378.53	376.45	362.82	340.81	318.43	296.85	282.83	288.82	300.12	322.34	347.9	367.09	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	5.92	x	11.28	x	0.63	x	0.7	=	20.41	(75)
Northeast 0.9x	0.77	x	5.92	x	22.97	x	0.63	x	0.7	=	41.55	(75)
Northeast 0.9x	0.77	x	5.92	x	41.38	x	0.63	x	0.7	=	74.86	(75)
Northeast 0.9x	0.77	x	5.92	x	67.96	x	0.63	x	0.7	=	122.95	(75)
Northeast 0.9x	0.77	x	5.92	x	91.35	x	0.63	x	0.7	=	165.27	(75)
Northeast 0.9x	0.77	x	5.92	x	97.38	x	0.63	x	0.7	=	176.19	(75)
Northeast 0.9x	0.77	x	5.92	x	91.1	x	0.63	x	0.7	=	164.82	(75)
Northeast 0.9x	0.77	x	5.92	x	72.63	x	0.63	x	0.7	=	131.4	(75)
Northeast 0.9x	0.77	x	5.92	x	50.42	x	0.63	x	0.7	=	91.22	(75)
Northeast 0.9x	0.77	x	5.92	x	28.07	x	0.63	x	0.7	=	50.78	(75)
Northeast 0.9x	0.77	x	5.92	x	14.2	x	0.63	x	0.7	=	25.69	(75)
Northeast 0.9x	0.77	x	5.92	x	9.21	x	0.63	x	0.7	=	16.67	(75)
Southwest0.9x	0.77	x	5.92	x	36.79		0.63	x	0.7	=	66.57	(79)
Southwest0.9x	0.77	x	5.92	x	62.67		0.63	x	0.7	=	113.39	(79)
Southwest0.9x	0.77	x	5.92	x	85.75		0.63	x	0.7	=	155.15	(79)
Southwest0.9x	0.77	x	5.92	x	106.25		0.63	x	0.7	=	192.23	(79)
Southwest0.9x	0.77	x	5.92	x	119.01		0.63	x	0.7	=	215.32	(79)
Southwest0.9x	0.77	x	5.92	x	118.15		0.63	x	0.7	=	213.76	(79)
Southwest0.9x	0.77	x	5.92	x	113.91		0.63	x	0.7	=	206.09	(79)
Southwest0.9x	0.77	x	5.92	x	104.39		0.63	x	0.7	=	188.87	(79)
Southwest0.9x	0.77	x	5.92	x	92.85		0.63	x	0.7	=	167.99	(79)
Southwest0.9x	0.77	x	5.92	x	69.27		0.63	x	0.7	=	125.32	(79)
Southwest0.9x	0.77	x	5.92	x	44.07		0.63	x	0.7	=	79.73	(79)
Southwest0.9x	0.77	x	5.92	x	31.49		0.63	x	0.7	=	56.97	(79)
Rooflights 0.9x	1	x	4.3	x	26	x	0.63	x	0.8	=	50.71	(82)
Rooflights 0.9x	1	x	4.3	x	54	x	0.63	x	0.8	=	105.33	(82)
Rooflights 0.9x	1	x	4.3	x	96	x	0.63	x	0.8	=	187.25	(82)
Rooflights 0.9x	1	x	4.3	x	150	x	0.63	x	0.8	=	292.57	(82)
Rooflights 0.9x	1	x	4.3	x	192	x	0.63	x	0.8	=	374.49	(82)
Rooflights 0.9x	1	x	4.3	x	200	x	0.63	x	0.8	=	390.1	(82)
Rooflights 0.9x	1	x	4.3	x	189	x	0.63	x	0.8	=	368.64	(82)
Rooflights 0.9x	1	x	4.3	x	157	x	0.63	x	0.8	=	306.23	(82)
Rooflights 0.9x	1	x	4.3	x	115	x	0.63	x	0.8	=	224.31	(82)
Rooflights 0.9x	1	x	4.3	x	66	x	0.63	x	0.8	=	128.73	(82)
Rooflights 0.9x	1	x	4.3	x	33	x	0.63	x	0.8	=	64.37	(82)
Rooflights 0.9x	1	x	4.3	x	21	x	0.63	x	0.8	=	40.96	(82)

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

(83)m=	137.69	260.27	417.26	607.75	755.08	780.05	739.55	626.49	483.52	304.83	169.78	114.6	(83)

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

(84)m=	516.22	636.72	780.08	948.56	1073.5	1076.9	1022.38	915.32	783.64	627.18	517.69	481.69	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (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	0.99	0.98	0.94	0.83	0.65	0.5	0.56	0.83	0.97	0.99	1	(86)

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

(87)m=	19.15	19.38	19.77	20.31	20.71	20.93	20.98	20.97	20.8	20.25	19.65	19.18	(87)

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

(88)m=	19.57	19.58	19.59	19.65	19.66	19.72	19.72	19.73	19.7	19.66	19.64	19.61	(88)

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

(89)m=	1	0.99	0.97	0.91	0.77	0.54	0.36	0.42	0.74	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=	17.16	17.5	18.07	18.87	19.39	19.68	19.71	19.72	19.54	18.82	17.93	17.23	(90)

fLA = Living area ÷ (4) = 0.37 (91)

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

(92)m=	17.9	18.2	18.7	19.41	19.88	20.14	20.18	20.18	20.01	19.35	18.57	17.95	(92)

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

(93)m=	17.9	18.2	18.7	19.41	19.88	20.14	20.18	20.18	20.01	19.35	18.57	17.95	(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	0.99	0.97	0.91	0.78	0.58	0.41	0.48	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	513.23	628.66	755.09	861.8	839.24	624.21	420.36	434.93	601.48	596.88	512.21	479.59	(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=	1848.41	1789.73	1625.2	1330.52	1025.12	660.25	426.93	446.38	717.82	1096.61	1467.37	1795.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	993.38	780.24	647.36	337.48	138.29	0	0	0	0	371.8	687.72	979.33	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 4935.6 (98)

Space heating requirement in kWh/m²/year — 60.45 (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		93.2	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	993.38	780.24	647.36	337.48	138.29	0	0	0	0	371.8	687.72	979.33		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1065.86	837.17	694.59	362.1	148.38	0	0	0	0	398.93	737.89	1050.79		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5295.71	(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)														
	165.14	144.78	150.19	132.08	127.58	111.34	104.42	118.06	118.95	137.11	148.19	160.31		
Efficiency of water heater													87.3	(216)
(217)m=	89.77	89.73	89.64	89.36	88.78	87.3	87.3	87.3	87.3	89.4	89.67	89.78		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	183.95	161.34	167.55	147.8	143.7	127.54	119.61	135.24	136.26	153.36	165.26	178.56		
Total = Sum(219a)$_{1...12}$ =													1820.17	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5295.71	
Water heating fuel used			1820.17	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			351.14	(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	=	1143.87	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	393.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1537.03	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	182.24	(268)
Total CO2, kg/year			sum of (265)…(271) =		1758.19	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		21.53	(273)
EI rating (section 14)					81	(274)

Appendix C

Part G Water Use calculations

Job no:	17282
Date:	19th May 2017
Assessor name:	Neil Ingham
Registration no:	STRO010493
Development name:	13-15 Johns Mews
Issue Date:	19th May 2017

Rainwater **Greywater** **Results**

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS

(for use with the Code for Sustainable Homes issues Wat 1 for the May 2009 and subsequent versions)

Dwelling Description	Typical 2 bed 2 bath Flat

1st step - Select from options below:

Is a Rain and/or Greywater system specified?	**No**
Is a shower AND bath present?	**Yes**
Has a washing machine been specified?	**No**
Has a dishwasher been specified?	**No**

2nd step - Build spreadsheet (click button below)

BUILD SPREADSHEET

As soon as this button is pressed the spreadsheet will change according to the options selected previously in the 1st step. Scroll down to see the changes.

3rd step - Enter consumption details for the specified fittings

TAPS (excluding kitchen taps)	**Fitting type**	**Flow rate (litres/min)**	**Number of fittings**
1	Basin Taps	4.50	2
2			
3			
4			
		Proportionate flow rate (litres/min)	3.15
		Consumption / person / day (Litres)	**8.69**

BATHS		Fitting type	Capacity to overflow (litres)	Number of fittings
	1	Main Bath	155.00	1
	2			
	3			
	4			
		Proportionate capacity to overflow (litres)		108.50
		Consumption / person / day (Litres)		**17.05**

SHOWERS		Fitting type	Flow rate (litres/min)	Number of fittings
	1	Shower	9.00	2
	2			
	3			
	4			
		Proportionate flow rate (litres/min)		6.30
		Consumption / person / day (Litres)		**39.33**

DISHWASHER	
Where no dishwasher is specified, a default consumption figure of 1.25 litres per place setting is used.	
Consumption / person / day (Litres)	**4.50**

WASHING MACHINES	Number of fittings
Where no washing machine is specified, a default consumption figure of 8.17 litres per kilogram of dry load is	

used.	
Where no washing machines have been specified but plumbing for future supply of grey/rainwater was installed, please enter details:	
Consumption / person / day (Litres)	**17.16**

WC's	Fitting Type	Flush Type	Volume**	Number of fittings
1	Dual Flush	Full Flush	4.50	2
		Part Flush	3.00	
2		Full Flush		
		Part Flush		
3		Full Flush		
		Part Flush		
4		Full Flush		
		Part Flush		
		Average effective flushing volume (litres)		3.50
		Consumption / person / day (Litres)		**15.47**

KITCHEN SINK TAPS	Fitting Type	Flow rate (litres/minute)	Number of fittings
1	Kitchen Tap	5.50	1
2			
3			
4			
	Proportionate flow rate (litres/min)		3.85
	Consumption / person / day (Litres)		**12.78**

WASTE DISPOSAL UNIT	
Is a waste disposal unit specified for the dwelling?	No
Consumption / person / day (Litres)	**0.00**

WATER SOFTENER	
Water Softener in use?	No
Total capacity used per regeneration (%)	

Water consumed per regeneration (litres)	
Average number of regeneration cycles per day (No.)	
Number of occupants served by the system (No.)	
Water consumed beyond 4% person / day (Litres)	**0.00**

4th step - Analyse Results

Go to Start

INTERNAL WATER CONSUMPTION

NET INTERNAL WATER CONSUMPTION	(litres/person/day)	**114.98**
RAINWATER ONLY COLLECTION SAVING	(litres/person/day)	**0.00**
GREYWATER ONLY RECYCLING SAVING	(litres/person/day)	**0.00**
RAIN/GREYWATER COLLECTION SAVING (combined system)	(litres/person/day)	**0.00**
NORMALISATION FACTOR	(litres/person/day)	**0.91**
TOTAL WATER CONSUMPTION	(litres/person/day)	**104.6**
	CSH CREDITS ACHIEVED	**3**
	CSH MANDATORY LEVEL:	**Level 3/4**

17. K COMPLIANCE

EXTERNAL WATER USE	(litres / person / day)	5.00
TOTAL WATER CONSUMPTION	(litres / person / day)	**109.6**
	17. K COMPLIANCE?	**Yes**

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 75% (maximum)