Energy Assessment
The Bird in Hand, Kilburn

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Executive summary

About the Scheme
The proposal comprises refurbishment of a three-storey pub (1 unit) including a basement and 9 newly built apartments. The development is located in the London Borough of Camden with a total NIA of approximately 770 sqm.

Planning policy
The scheme has been developed in accordance with the London Plan 2021 "The Spatial Development Strategy for Greater London, March 2021" and with the Sustainable, Design and Construction SPG. According to the planning policies, the scheme should achieve:

- Zero carbon target
- A minimum on-site CO2 reduction of at least 35% beyond Building Regulations
- Residential development should achieve 10% CO2 improvement through energy efficiency measures, 'Be Lean' stage
- As least 20% CO2 improvement through renewable technologies, 'Be Green' stage
- Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
    - through a cash in lieu contribution to the borough's carbon offset fund, or
    - off-site provided that an alternative proposal is identified, and delivery is certain

Summary
All flats and the refurbished house have been modelled for the purposes of the energy assessment. High energy efficiency performance building services have been used for these units in order to achieve the required carbon emission targets.

The scheme complies with the 2013 Building Regulations Part L and the minimum energy efficiency targets in the following documents have been followed:

- New build (Part L1A) – The actual building CO2 emissions rate (DER) is no greater than the notional building CO2 target emissions rate.
- Refurbishment (Part L1B) – Consequential improvements to refurbished areas have been made to ensure that the building complies with Part L, to the extent that such improvements are technically, functionally, and economically feasible.

In addition, the CO2 emissions of the scheme have been calculated using the SAP 10.0 carbon emission factors, and the scheme can achieve:

- An on-site CO2 reduction of 68.5% beyond Building Regulations achieved through energy efficiency measures and maximised of renewable technologies (Communal Air Source Heat Pumps and PV panels)
- The development achieves 18.8% CO2 improvement through energy efficiency measures, 'Be Lean' stage
- A further improvement of 49.7% CO2 has been achieved through renewable technologies 'Be Green' stage (Air Source Heat Pumps and PV panels)
- Overall, the scheme achieves an improvement of 68.5% through measures on-site
- Zero-carbon target can be achieved through a cash in lieu contribution to the borough's carbon offset fund. The carbon offset payment cost has been calculated as £15,210.

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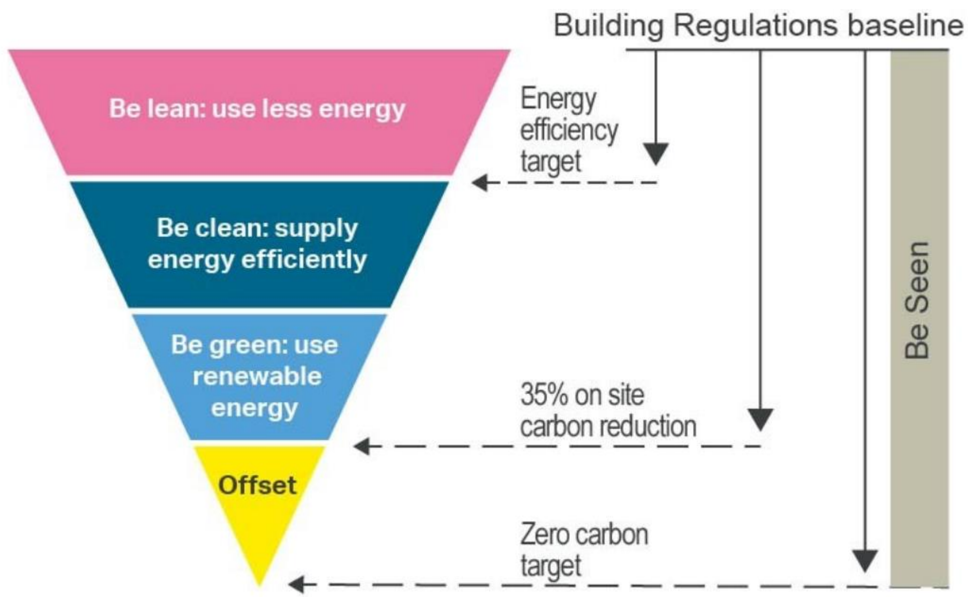
Energy hierarchy
The proposed scheme has followed the energy hierarchy that is illustrated below:



Source: Greater London Authority

Key measures
Key measures identified for each stage are shown below:

- Be Lean:
  - Low U-values for opaque elements and fenestration
  - Low g-value
  - Low air permeability
  - High efficiency lighting
  - Mechanical ventilation with heat recovery
  - Green roof
- Be Clean:
  - No measures identified
- Be Green:
  - Communal Air Source Heat Pumps to provide space heating and hot water
  - Photovoltaic panels

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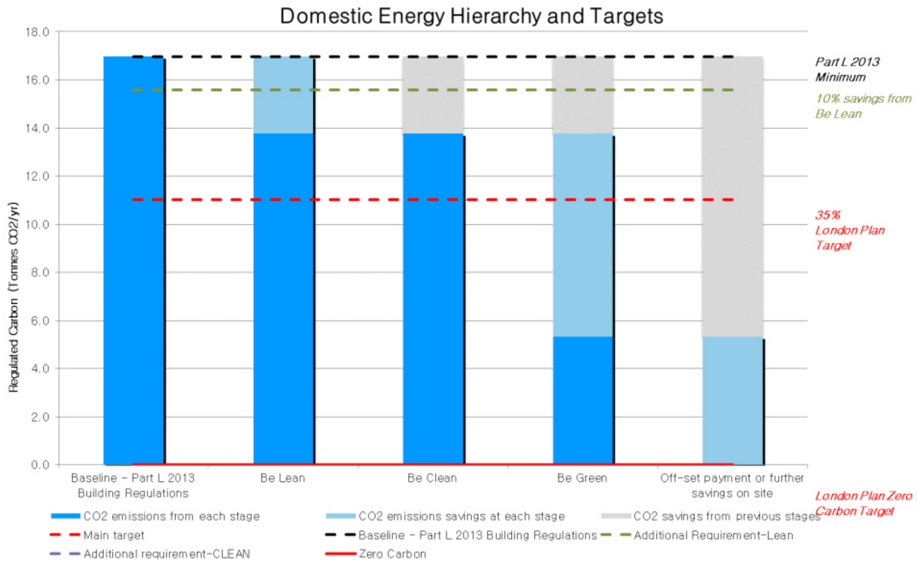
GLA's Energy Hierarchy: Regulated carbon emissions

The proposed scheme has followed the energy hierarchy. A graphical illustration of how the scheme performs in relation to Building Regulations and the Energy Hierarchy is shown below. Carbon dioxide emission factors for SAP 10.0 have been used for the calculation.

As demonstrated in the figure the proposed scheme will reduce carbon emissions by 18.8% from the fabric energy efficiency measures described in the 'Be Lean' section and will reduce total carbon emissions by 68.5% over Existing Building and Building Regulations (using SAP 10.0 carbon dioxide emission factors) with the further inclusion of low and zero carbon technology (Air source heat pumps and photovoltaic panels).

Therefore, the scheme meets and exceeds the planning policy carbon reduction target and complies with London Plan 2021 Policy SI2.

The carbon offset payment to meet the zero-carbon target has been calculated as £15,210.



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Regulated CO_2 emissions

Site-wide				
GLA's Energy Hierarchy: Regulated CO2 - Calculated using SAP 2012 CO2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO2 emissions (tCO2/yr)	18.58	15.85	-	11.89
CO2 emissions saving (tCO2/yr)	-	2.73	-	3.96
Saving from each stage (%)	-	14.7	-	21.3
Total CO2 emissions saving (tCO2/yr)	6.69			
36% total CO2 savings over Existing Building and 2013 Building Regulations Part L achieved				
GLA's Energy Hierarchy: Regulated CO2 - Calculated using SAP 10.0 CO2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO2 emissions (tCO2/yr)	16.96	13.77	-	5.34
CO2 emissions saving (tCO2/yr)	-	3.19	-	8.44
Saving from each stage (%)	-	18.8	-	49.7
Total CO2 emissions saving (tCO2/yr)	11.63			
68.5% total CO2 savings over Existing Building and 2013 Building Regulations Part L achieved				

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Carbon Emission Factors

Emission factors:

The Greater London Authority (GLA) Guidance on Energy Assessments published in October 2018 highlights a critical development regarding carbon emission factors. Grid electricity has significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emission factors (SAP 10.0) demonstrating this. Although SAP 10.0 is not in use yet, the GLA Guidance encourages the use of SAP 10.0 carbon emission factors from January 2019 in areas where there are no opportunities to connect to existing or planned district heat networks. Any applicants proposing to use the SAP 2012 emissions factors is required to provide adequate justification.

SAP 2012 emission factors can be used where:

- The scheme is located within a Heat Network Priority area; and
- There is potential to connect to an existing network using gas-engine CHP or a new network using low-emission CHP; and
- The heat network operator has, or is in the process of developing, a strategy to decarbonise the network and has shared it with the GLA

While the proposed scheme is expected to comply with SAP 2012 for Building Regulation compliance, the assessment presents total emissions using SAP10.0 as it is required for demonstrating performance against planning policy targets. The revised factors are below:

Fuel Type	Carbon Factor (kg CO2/kWh)		
	SAP 2012	SAP10.0	SAP 10.2
Natural Gas	0.216	0.210	0.210
Grid Electricity	0.519	0.233	0.136

The carbon emissions of the scheme have been calculated using Building Regulations methodology for estimating energy performance against Part L 2013 requirements, and the outputs have been manually converted for the SAP 10.0 emission factors using a spreadsheet.

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Establishing Carbon Emissions

Methodology

The purpose of an energy assessment is to demonstrate that climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy. It also ensures energy remains an integral part of the scheme's design and evolution.

The methodology followed in this report follows the guidance set out by the Greater London Authority (GLA) for developing energy strategies as detailed in the document. "Energy Assessment Guidance: Greater London Authority guidance on preparing energy assessments as part of planning applications (April 2020)". The scheme has been developed in accordance with the London Plan 2021.

This report has followed these documents and comprises the following components:

- Baseline: A calculation of the Part L 2013 Building Regulations compliant CO2 emission baseline using approved software. The baseline assumes a gas boiler would provide heating and any active cooling would be electrically powered (For refurbishments, Appendix 4 of GLA's Guidance has been used).
- Be Lean: A calculation of the impact of demand reduction measures. For example, passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading, and active design measures such as high efficacy lighting and efficient mechanical ventilation with heat recovery.
- Cooling Hierarchy: In accordance with London Plan 2021Policy SI4, measures that are proposed to reduce the demand for cooling have been set out such as minimisation of solar and internal gains and night cooling strategies.
- Be Clean: In accordance with London Plan 2021 Policy SI3, this report has demonstrated how the scheme has selected heating, cooling and power systems to minimise carbon emissions. This comprises an evaluation of the feasibility of connecting to existing low carbon heat networks, planned networks, site-wide and communal heat networks, and CHP.
- Be Green: In accordance with London Plan 2021 Policy SI2, this report has conducted a feasibility assessment of renewable energy technologies. This comprised a site-specific analysis of the technologies and, if applicable, how they would be integrated into the heating and cooling strategy for the scheme.
- Be Seen: monitor, verify and report on energy performance through the Mayor's post construction monitoring platform.

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Establishing CO2 emissions

As required by the GLA both the regulated and unregulated emissions of the development must be quantified and demonstrated. The total emissions for the scheme are shown below.

CO2 Emissions – Regulated and Unregulated (tonnes CO2/yr) - SAP 10.0 – Site-wide			
	Regulated Emissions	Unregulated Emissions	Total Emissions
Baseline: Part L 2013	16.96	5.96	22.93
Be Lean: Use less energy	13.77	5.96	19.74
Be Clean: Supply energy efficiently	-	-	-
Be Green: Use renewable energy	5.34	5.96	11.30

Carbon offsetting

London Plan 2021 Policy SI2, requires carbon dioxide reductions to be achieved as far as possible on-site and a cash in lieu contribution will be considered acceptable only in instances where it has been clearly demonstrated that no further savings can be achieved on-site. The remaining savings to reach zero carbon can be achieved either off-site or via a cash in lieu contribution.

The annual shortfall is determined by subtracting the overall regulated carbon dioxide savings from the target savings. The result is then multiplied by the assumed lifetime of the development's services (30 years) to give the cumulative shortfall. The cumulative shortfall is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution, as shown below. The cumulative savings for offset payment and the cash-in-lieu contribution have been anticipated and tabulated below, using SAP 10.0 carbon emission factors and an offset price of £95 per tonne.

Regulated carbon dioxide savings from each stage of the energy hierarchy – SAP 10.0		
	(tonnes CO2/yr)	%
Be Lean: Savings from energy demand reduction	3.19	18.8%
Be Clean: Savings from heat networks	0.00	0.0%
Be Green: Savings from renewable energy	8.44	49.7%
Cumulative on-site savings	11.63	68.5%
Carbon shortfall	5.34	-
	(tonnes CO2)	
Cumulative savings for offset	160.11	
Cash-in-lieu contribution	£15,210	

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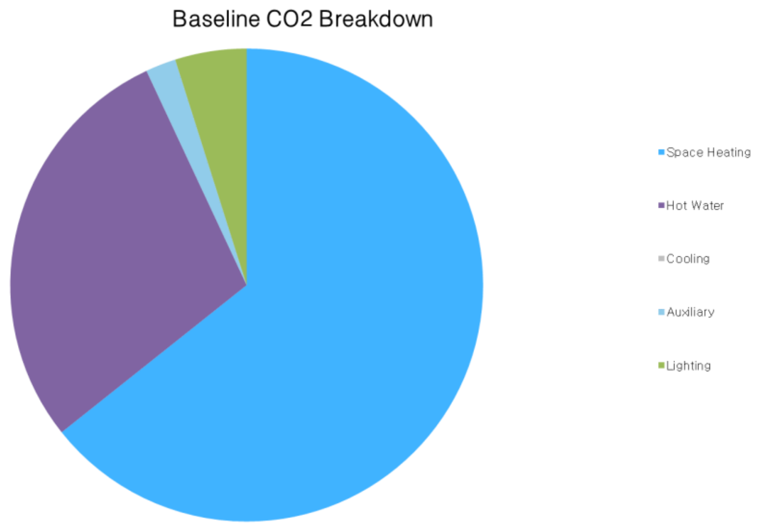
Baseline

Building regulations Part L 2013 minimum compliance
The total baseline carbon emissions for the whole scheme is 16.96 tonnes CO2/yr (using SAP 10.0 carbon dioxide emission factors).

The pie chart provides a breakdown of the specific carbon emissions by system over the course of one year. The chart shows that space heating is the primary source of carbon dioxide emissions, and hot water is the second largest, across the scheme as a whole.

Carbon Emissions in tonnes CO2/yr.				
Heating	Hot Water	Cooling	Auxiliary	Lighting
11.44	4.58	0.00	0.17	0.78



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Demand Reduction

Be Lean: summary

Demand reduction measures have reduced the scheme's carbon emissions by 18.8% (using SAP 10.0 figures) over the minimum Part L 2013 Building Regulations baseline for new built and over Appendix 4 of GLA's Guidance for refurbishment.

U-values

Domestic – new built		
Element	Minimum Building Regulations U-value W/m2K	Proposed U-value W/m2K
Flat roof	0.20	0.18
Wall	0.30	0.15
Corridor wall	0.30	0.15
Ground floor	0.25	0.15
Exposed floor	0.55	0.15
Windows	2.00	1.60 (g value – 0.55)
Rooflights	2.00	1.60 (g value – 0.55)
Doors	2.00	1.0

Party walls will be fully filled cavity with effective sealing at all exposed edges and in line with insulation layers in abutting elements.

Domestic - refurbishment		
Element	Existing Building U-value W/m2K Appendix 4 (GLA guidance 2020)	Proposed U-value W/m2K
Flat roof	0.18	0.18
Pitched roof	0.18	0.18
Wall	0.55	0.55
Wall (new)	0.30	0.15
Corridor wall	0.55	0.55
Ground floor	0.55	0.25
Exposed floor	0.55	0.25
Windows	1.60 (g value – 0.63)	1.60 (g value – 0.55)
Rooflights	1.60 (g value – 0.63)	1.60 (g value – 0.55)

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Air permeability

A reduced air permeability has been targeted as per the table below:

Air permeability (m3/hm2 @50 Pa)	Minimum Building Regulations	Existing Building Appendix 4 (GLA guidance 2020)	Proposed
House	15	15	8
Flats	10	-	3

This will require careful attention to two key areas:

- Structural leakage
- Services leakage

Structural leakage occurs at joints in the building fabric and around window and door openings, loft hatches and access openings. There will also be some diffusion through materials such and cracks in masonry walls typically caused by poor perpends in the blockwork or brickwork. Structural leakage is hard to remedy retrospectively therefore good detailing at the design stage is essential.

Services leakage occurs at penetrations from pipes and cables entering the building. These can be sewerage pipes, water pipes and heating pipes. As well as electricity cables there may also be telecommunication cables. Attention, therefore, needs to be paid to sealing all penetrations during construction.

Thermal Bridging:

The new dwellings within the scheme will be designed in line with the accredited construction details (ACD) and therefore it has been indicatively modelled with the accredited thermal bridge Psi-values for the following junctions:

- Lintels (E2)
- Sill (E3)
- Jambs (E4)
- Ground floor (E5)
- Party floor between dwellings (E7)
- Corners (E16)
- Corners inverted (E17)

A bespoke thermal bridging calculation will be required for the following junctions in the new dwellings in order to achieve the specified Psi-values:

- Balcony (E23); 0.30 W/mK

The default psi-value has been used for the remaining junctions.

Thermal Mass:

Thermal mass of the scheme has been indicatively modelled as 250 kJ/m2K (medium).

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Heating
For the 'Be Lean' scenario, the scheme has been modelled with a gas boiler with an efficiency of 89.5% (as required by the GLA). For the 'Be Green' final scenario, a communal air source heat pump with a minimum COP of 2.80 will be proposed as the main heating system. Heat will be provided via radiators and will be controlled with a charging system linked to use of community with programmer and TRVs.

Hot Water
For the 'Be Lean', the hot water will be provided by the main gas heating system (gas boilers with an efficiency of 89.5%). For the 'Be Green' final scenario, hot water will be provided by the air source heat pump, with a minimum COP of 2.80. A top-up electric immersion heater will provide less than 20% of the hot water demand.

Ventilation
Balanced ventilation with heat recovery has been specified for the apartments.

- The apartments with one toilet have been modelled with an SFP of 0.76 W/l/s and a heat recovery efficiency of 91%.
- The apartments with two toilets have been modelled with an SFP of 0.88 W/l/s and a heat recovery efficiency of 91%.
- The house with two toilets have been modelled with an SFP of 0.88 W/l/s and a heat recovery efficiency of 91%.

Cooling
No cooling has been specified for the development.

Lighting
High efficiency lighting has been specified for the development with a minimum efficacy of 75 lumens/W.

Energy demand following energy efficiency measures (MWh/year)

	Space Heating	Hot water	Lighting	Auxiliary	Cooling	Unregulated gas	Unregulated electricity
House	16.3	2.6	0.6	0.7	0.0	0.0	4.7
Flats	20.8	19.3	2.6	2.1	0.0	0.0	20.9

Fabric energy efficiency

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
House	20.69	17.16	17%
Flats	30.88	35.14	12%

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Cooling and Overheating

Overheating and cooling

The aim of this section is to reduce the impact of the urban heat island effect in London and encourage the design of spaces to avoid overheating and excessive heat generation, and to mitigate overheating due to the impact of climate change.

Where design measures and the use of natural and/or mechanical ventilation are not enough to guarantee the occupant's comfort, in line with the cooling hierarchy the development's cooling strategy must include details of the active cooling plant being proposed, including efficiencies, and the ability to take advantage of free cooling and/or renewable cooling sources.

Where appropriate, the cooling strategy should investigate the opportunities to improve cooling efficiencies through the use of locally available sources such as ground cooling and river/dock water-cooling.

The Cooling Hierarchy in Policy SI4

Developments should reduce potential overheating and reliance on air conditioning systems and demonstrate this with the Cooling Hierarchy:

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure
2. Minimise internal heat generation through energy efficient design
3. Manage the heat within the building through exposed internal thermal mass and high ceilings
4. Provide passive ventilation
5. Provide mechanical ventilation
6. Provide active cooling systems

Avoiding overheating: measures taken

The following measures have been taken in accordance with the cooling hierarchy to reduce overheating and the need for cooling:

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure
   - Solar control – all methods controlling solar gain to within tolerable limits have been considered. The location, size, design and type of window openings and glazing have been optimised and reduced solar gain factors from low emissivity windows have been specified.
   - Green roofs – a green roof has been specified for the scheme at the fourth-floor roof for the flats. This will act as an insulation barrier and the ecological processes will reduce the amount of solar energy absorbed by the roof membrane, so will reduce temperatures below the surface and cool the building areas directly below.
   - Dark-coloured curtain/roller blinds will be specified to limit solar gain. The shading has also been optimised to avoid substantially reducing daylighting or increasing the requirement for electric lighting.
   - Insulation levels have been maximised and the resulting U-values are lower than required by Building Regulations. The build-ups therefore prevent the penetration of heat as much as practically possible. See the 'Be Lean' section of this report for target U-values.
   - A reduced air permeability rate has been targeted to minimise uncontrolled air infiltration. This will require attention to detailing and sealing. See 'Be Lean' section of this report for details of how this will be achieved.

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2. Minimise internal heat generation through energy efficient design
    - Internal heat gains have been minimised where possible. Energy efficient appliances will help reduce internal heat gain and reduce the cooling requirement.
    - Energy efficient lighting will also be specified as per the 'Be Lean' section. Occupancy and daylight sensors will also be specified to reduce unnecessary lighting usage.
    - Heat distribution infrastructure within building will be designed to minimise pipe lengths, particularly lateral pipework in corridors of the apartment block. Twin pipes configuration will be adopted to minimise heat loss.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings
    - High thermal mass – exposed building fabric materials such as masonry or concrete have been utilised in the form of concrete floors. These materials act as 'thermal batteries'; they absorb heat gains during the day when the building is occupied and 'store' it for an extended period, thereby helping to stabilise daytime temperatures. At night this heat can be dissipated, which 'resets' the heating cycle. Ventilation will also be used at night to purge the stored heat within the structure. A 'ground coupled' system that uses the thermal storage capacity of the ground has not been specified as the passive ventilation option has been selected instead.
    - Room heights – high ceilings are traditionally used in hot climates to allow thermal stratification so that occupants can inhabit the lower cooler space, and to decrease the transfer of heat gain through the roof. The proposed building has floor to ceiling heights of more than 2.5m. As the roof will be well insulated to below building regulations, there will be minimal penetration of heat through the roof.
4. Provide passive ventilation
    - Openable windows are specified on all facades of the building.
    - Shallow floorplates have been specified with dual aspect units to allow for cross ventilation. Cross ventilation will be achieved by opening windows on two facades and ensuring there is a clear path for airflow.
    - Night time cooling will also be utilised. This will work in tandem with high thermal mass materials specified. The larger temperature differential that exists between internal and external temperatures at night will allow effective stack ventilation and purging of heat accumulated within the structure during the day.
5. Provide mechanical ventilation
    - Mechanical ventilation with summer by-pass will be used for all residential units use of 'free cooling' where the outside air temperature is below that in the building during summer months.
    - The mechanical systems will comply with the Domestic Building Services Compliance Guide as it is demonstrated in the 'Be Lean' section.

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Overheating risk

The overheating risk considering all the above-described passive measures have been assessed for the scheme:

Areas	Overheating risk from SBEM and SAP
House	Not significant
Flat G01	Not significant
Flat 101	Not significant
Flat 102	Not significant
Flat 201	Not significant
Flat 202	Not significant
Flat 301	Not significant
Flat 302	Not significant
Flat 401	Not significant
Flat 402	Not significant

According to the GLA guidance on preparing energy assessments (April 2020) Section 8, a dynamic modelling in line with CIBSE TM59 should be carried out to assess the risk of overheating. However, since the SAP outputs indicate that overheating risk is 'not significant' a dynamic overheating assessment has not been carried out at this stage.

Active cooling

Air conditioning has not been specified for the scheme.

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Heating Infrastructure

Heating infrastructure including CHP

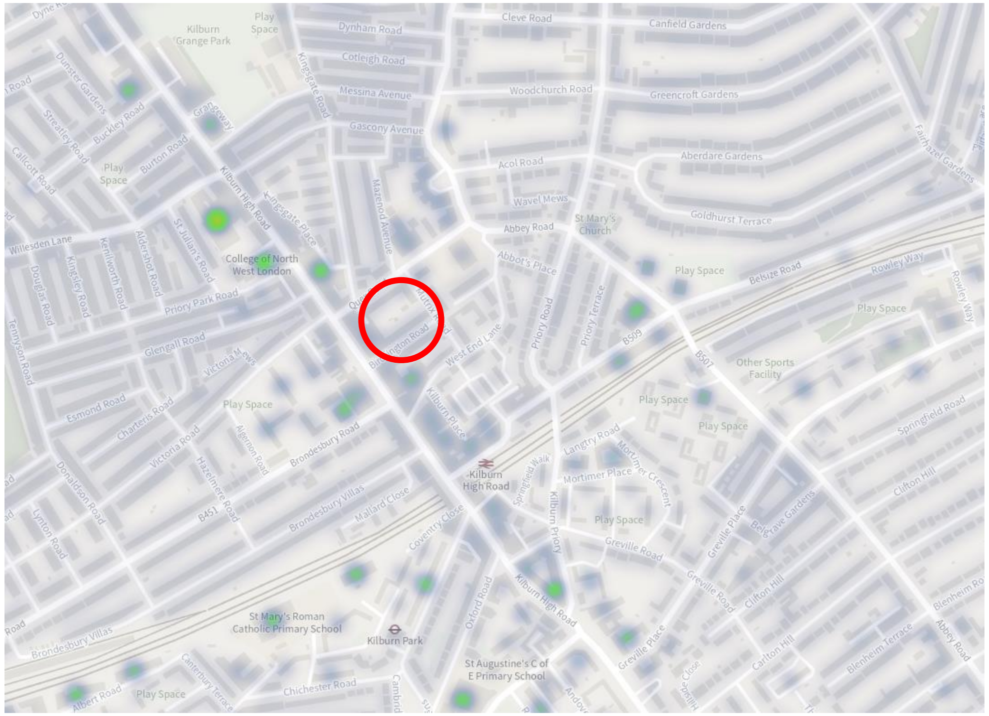
Once demand for energy has been minimised, schemes must demonstrate how their energy systems have been selected in accordance with the order of preference in Policy SI3 of London Plan 2021. This has involved a systematic appraisal of the potential to connect to existing or planned heating networks and on site communal and CHP systems.

To comply with London Plan 2021 Policy SI 3, developments in Heat Network Priority Areas (HNPAs) should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

- connect to local existing or planned heat networks
- use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
- use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
- use ultra-low NOx gas boilers

Connect to local existing or planned heat network

The illustration below shows the London heat map. The red circle shows the location of the proposed scheme.



A review of the London Heat Map demonstrates that there are no existing networks present within connectable range of the scheme. Therefore, a connection is not possible.

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Use zero-emission and/or local secondary heat sources

According to the GLA and London Plan 2021 Policy SI3, the exploitation of local energy opportunities to maximise the use of locally available energy sources whilst minimising primary energy demand and carbon emissions is encouraged. Secondary heat includes environmental sources such as air, water and ground; and waste sources such as heat from the sewerage system, sewage treatment plants, the tube network, data centres and chiller systems.

There are no local available waste heat sources for the scheme.

Use low-emission combined heat and power (CHP)

In accordance with section 9 of the GLA guidance for Energy Planning where connection to an area wide heat network will not be available in the foreseeable future i.e. 5 years following completion, or the development is of such a scale that it could be the catalyst for an area wide heat network, applicants should evaluate the feasibility of on-site CHP

GLA guidance stipulates that small, or purely residential developments of less than 350 dwellings will not be expected to include on-site CHP. CHP systems are best utilised where there is a consistent and high demand for heat. Because of the small electricity supplies and demand of this scheme, a CHP installed to meet the base heat load would typically require the export of electricity to the grid.

The heat demand profile of this residential scheme is not suitable to CHP. The implemented fabric improvements from the 'Be Lean' scenario have also reduced the energy demand from space heating to hot water. For CHP systems to be economically viable they need to run for at least 5,000 hours per year. Therefore, a CHP system would most likely be oversized, and as a result less efficient and economic.

Use ultra-low NOx gas boilers

Where it is clearly demonstrated that the above heating options (District heating, local secondary heat source and CHP) have been fully investigated and ruled out, then a site-wide heating strategy led by ultra-low NOx gas boilers can be considered.

The scheme will adopt a site wide ASHP heating network. This will comprise a single energy centre for the scheme where all mechanical heat generating plant will be housed. The communal heating system will serve all of the units within the scheme The results of the communal ASHP heating network are presented in the 'Be Green' stage (renewable technologies).

The design team has investigated the options of reducing the distribution losses by:

- Reducing the lateral pipe lengths
- Use of variable flow control systems to lower flow rates and lower return temperatures at part-load
- System will operate with low return temperature with low return temperatures in line with the CIBSE Heat Networks: Code of Practice for the UK.

Air quality impacts

An air quality assessment is required for all major developments as per the London Plan 2021 policy SI1. To ensure that the air quality assessment is as robust as possible, the total gas and electricity consumption is shown in Appendix A, as it is required by GLA.

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Renewable Energy

Renewable Energy Feasibility:
In line with Policy SI2 of the London Plan 2021 the feasibility of renewable energy technologies has been considered. A detailed site-specific analysis and associated carbon saving calculations has also been provided for renewable energy technologies considered feasible.

Each technology has been assessed under 3 broader categories. There are key criteria for each category on which the technology is evaluated. The key criteria have been given a weighting based on a tick-system, a graphical representation of this is shown below:

The weighting of each of the criteria within the categories is shown below:

- Local, site-specific impact: (Maximum score of 5)
  - Local planning criteria = ✓
  - Land used by all components = ✓
  - Noise impact from operation = ✓
  - Interaction on the current building design = ✓
  - Buildability of installation = ✓

- Economic viability: (Maximum score of 5)
  - Capital cost of all components = ✓
  - Grants and funding available = ✓
  - Payback periods (years) 3-5, 5-10, 10-15 = ✓
  - Servicing requirements (low or high) = ✓
  - Maintenance costs (low or high) = ✓

- CO2 and sustainability: (Maximum score of 10)
  - Carbon saving per year = ✓✓✓✓
  - Impact of future grid decarbonisation (gas vs. electric) = ✓✓
  - Local air quality/pollution = ✓✓
  - Resource use of installation = ✓✓

Key comments on each of the criteria and the corresponding score will be provided in a table for each of the technologies. The score for each of the criteria will be summed and each of the technologies will then be ranked. The assessment of each technology is undertaken on the following pages.

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Biomass & Biofuel - Rejected

Biomass is normally considered a carbon 'neutral' fuel, as the carbon dioxide emitted on burning has been recently absorbed from the atmosphere by photosynthesis. Although some form of fossil fuel derived inputs are required in the production and transportation of the fuel.

Wood is seen as a by-product of other industries and the small quantity of energy for drying, sawing, pelleting and delivery are typically discounted. Biomass from coppicing is likely to have external energy inputs from fertiliser, cutting, drying etc. and these may need to be considered. In this toolkit, all biomass fuels are considered to have zero net carbon emissions.

Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and is used commercially in the form of wood chips or pellets. Biomass boilers can also be designed to burn smokeless to comply with the Clean Air Acts.

Boilers can be fed automatically by screw drives from fuel hoppers. This typically involves daily addition of bagged fuels.

A biomass boiler could be installed on site for supplementary LTHW heating; however, a major factor influencing the suitability of a biomass boiler is the availability of the biomass fuel. A local and reliable fuel source would be essential for the biomass boiler to be an efficient replacement for a conventional boiler system. Therefore, a very comprehensive feasibility assessment needs to be undertaken to understand the practicalities of such a system.

It is estimated that the heating and hot water demand of the site is too large to meet the required CO2 emissions reduction if a biomass boiler was a standalone system. Therefore, a biomass boiler would need to be combined with energy demand reduction measures and/or CHP. The likely installed cost would be circa £50,000. The additional cost of providing and storing the bio-fuel also needs to be accounted for. The site is likely to be unsuitable for biomass boilers due to site constraints such as limited transport/access issues, and storage of the biomass fuel. A detailed feasibility study will be required to investigate the suitability.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO2 and sustainability (out of 10)
✓	✓✓✓	✓✓✓✓✓
Local air quality impacts, increased transport usage, increased plant space, slightly increased buildability issues.	Increased capital costs of installation, typical payback of 8 years, Increased maintenance relative to gas boiler, resource use not significantly increased if well serviced.	Very low carbon intensity of feedstock if properly procured. Decarbonisation impact not applicable, air quality issues.

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Photovoltaic Panels (PV) - Accepted

Photovoltaic systems convert energy from the sun into electricity through semi-conductor cells. Systems consist of semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn the direct current (DC) output into alternating current (AC) electricity for use in buildings.

Photovoltaic panels supply electricity to the building and are attached to electricity gird or to any other electrical load. Excess electricity can be sold to the National Grid when the generated power exceeds the local need. PV systems require only daylight, not sunlight to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions.

The cost of PV cells is heavily dependent on the size of the array. There are significant cost reductions available for larger installations.

The most suitable location for mounting photovoltaic panels is on roofs as they usually have the greatest exposure to the sun. The proposed site has a potential useable roof area of approximately 120 sqm including circulation area with approximately 40 sqm of PV panels (2 m2/panel for 20 panels) and is orientated south-west – north-east.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)
✓✓✓✓ No local air quality impacts, use of unutilised roof space, no noise issues, good orientation, and slightly increased buildability issues for wiring and metering.	✓✓ Increased capital costs of installation, typical payback of 10-15 years, Feed in Tariff available, limited servicing and maintenance i.e. 1 visit per year, inverter will require replacement.	✓✓✓✓✓ ✓✓✓ High carbon saving from electricity, uses minimal grid electricity, no local air impact, high embodied energy of panels.

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Solar Thermal – Rejected

Solar water heating systems use the energy from the sun to heat water for domestic hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building. The systems work very successfully in all parts of the UK, as they can work in diffuse light conditions.

Like photovoltaic panels the most suitable location for mounting solar hot water panels is on roofs as they usually have the greatest exposure to the sun.

It is estimated that the CO2 emissions reduction that would be produced by solar hot water as a standalone system would not be adequate to achieve the required CO2 emissions reduction target. Therefore, a solar hot water system would need to be combined with more energy efficiency strategies, a CHP, or additional renewable technologies to achieve the carbon reduction target.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)
✓✓✓ No local air quality impacts, no roof space, no noise issues, good orientation, slightly increased buildability issues for piping and cylinders.	✓✓✓ Increased capital costs of installation, typical payback of 8-10 years, Heat Incentive available, limited servicing and maintenance i.e. 1 visit per year, heat transfer fluid requires replacing every 10 years.	✓✓✓✓✓ ✓ Lower carbon saving as primarily displacing gas, uses minimal grid electricity, no local air impact, medium embodied energy of panels.

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Wind Energy – Rejected

Wind energy is a cost-effective method of renewable power generation. Wind turbines can produce electricity without carbon dioxide emissions in ranges from watts to megawatt outputs. The most common design is for three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower.

The blades drive a generator either directly or via a gearbox to produce electricity. The electricity can either be linked to the grid or charge batteries. An inverter is required to convert the electricity from direct current (DC) to alternating current (AC) for feeding into the grid.

Modern quiet wind turbines are becoming viable in low density areas where ease of maintenance and immediate connection to the grid or direct use of the electricity in a building, may make them cost effective, despite lower wind speeds than open areas.

Wind turbines are generally less suited to dense urban areas as their output will be affected by potentially lower and more disrupted wind speeds, and their use of much more cost-effective machines may be prohibited by their proximity to some building types. Small turbines can be used in inner city areas mounted on buildings, although there are relatively few installations.

A detailed wind resource evaluation would be required for the site to fully understand the generation potential and payback period. Also, it is likely that planning restrictions and resistance from groups within the local community could also affect the viability of wind energy for the project.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)
✓	✓✓✓✓	✓✓✓✓✓
No local air quality impacts, use of unutilised roof space, medium noise issues, relatively limited wind speeds in local area, increased buildability issues for wiring and metering.	Medium capital costs of installation, typical payback of 5 years, Feed in Tariff available, limited servicing and maintenance, costs of 2-3% typical.	High carbon saving from electricity, output limited from urban installation, consumes little grid electricity, no local air impact, low embodied energy of panels

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Ground Source Heat Pump (GSHP) – Rejected

Geo-thermal energy is essentially heat collected from the ground. Heat obtained from the ground may be considered it as a source of heating and cooling within the UK by the use of a geo-thermal heat pump or ground source heat pumps.

A ground source heat pump is a device for converting energy in the form of low-level heat to heat at a usable temperature. The heat pump consists of five main parts: ground collector loop/or boreholes, heat exchanger, compressor, condenser heat exchanger and expansion valve.

At approximately 1.2-1.5 metres down below ground level the temperature is a constant 10 to 12°C. Any boreholes would need to be sunk to an effective depth of 50 – 120m and a ground feasibility report would be required to ascertain if this method of heat source were viable.

From the boreholes pre-insulated pipework is laid in the ground to the heat exchanger device. The system is filled with water and antifreeze. The cooled water is pumped around the loop / borehole gathering energy as it circulates. The water that has been heated to 10-12°C is returned to the ground source heat exchanger where the energy is transferred to the refrigerant gas. For every 1kW of energy used to compress the refrigerant, the process 'gives up' 4 kW of energy for use in the system being used to heat the building.

The installation cost for a Ground Source Heat pump is typically high compared to a gas-boiler installation.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)
✓✓ No local air quality impacts, no visual impact, no noise issues, however the constrained site may prohibit its installation. Increased buildability issues for pipework and heating emitters internally.	✓ High capital costs of installation, typical payback >15 years where gas is displaced, Renewable Heat Incentive available, limited servicing and maintenance i.e. 1 visit per year, mechanical parts may require replacement over lifespan.	✓✓✓✓✓ ✓✓✓ Medium carbon saving from gas displacement, consumes some electricity so benefits from decarbonisation, no local air impact, high embodied energy of equipment.

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Air Source Heat Pump (ASHP) – Accepted

Air source heat pump systems work on the same principle as a ground source heat pump although they use the outside air as the heat source.

The coefficients of performance given by air source heat pump systems are inferior to that of ground source systems due to varying air temperatures. In the depth of winter, the energy efficiency of an air source system will be lower than that of a ground source system, and it is likely that more back-up heat will be required if an air source unit is fitted. This back-up heat often comes from a direct electric heater. They operate over a varying temperatures range of -15°C to +25°C, however, the performance will reduce to below the required 3 to 1 carbon saving ratio in winter, and they also require a defrosting mechanism to melt ice that forms on the air heat exchanger.

ASHPs are cheaper to install than ground source heat pumps but carbon dioxide emission savings will typically be less than that of a ground source heat pump.

Air source heat pumps would provide a suitable HVAC solution for commercial spaces which have relatively low heating demands as well as a regular need for cooling given the higher internal gains of these use classes. Having a system which is able to both, heat and cool provides versatility and reduces the amount installed plant.

The residential space has a relatively large domestic hot water demand which could be met with heat pumps if combined with another heating source to achieve the required DHW temperatures. The scheme could meet 80% of its hot water heating consumption via air source heat pumps, with the remaining 20% demand being met by another heating source.

Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)
✓✓✓✓ No local air quality impacts, use of unutilised roof space, over visual impact, low noise issues, increased buildability issues for pipework and heating emitters internally.	✓✓ Medium- high capital costs of installation, typical payback >15 years where gas is displaced, Renewable Heat Incentive available Limited servicing and maintenance i.e. 1 visit per year, mechanical parts may require replacement over lifespan.	✓✓✓✓✓ ✓✓ Medium carbon saving from gas displacement, less efficient in winter, consumes electricity so benefits from decarbonisation, no local air impact, high embodied energy of equipment.

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Summary comparison matrix

An assessment of the feasibility of each of the technologies is shown below.

Renewable Technology	Comments	Local, site-specific impact (out of 5)	Economic viability (out of 5)	CO_2 and sustainability (out of 10)	Total Score
Biomass Boiler	High air quality impact	✓	✓✓✓	✓✓✓✓✓	9
Photovoltaic	High CO_2 savings and low visual impact	✓✓✓✓	✓✓	✓✓✓✓✓ ✓✓✓	14
Solar Thermal	Low CO_2 savings compared to PV panels	✓✓✓	✓✓✓	✓✓✓✓✓ ✓	12
Wind Energy	High visual and noise impact	✓	✓✓✓✓	✓✓✓✓✓	10
GSHP	High capital cost	✓✓	✓	✓✓✓✓✓ ✓✓✓	11
ASHP	Low capital cost but low CO_2 savings compared to GSHP	✓✓✓✓	✓✓	✓✓✓✓✓✓ ✓	13

Photovoltaic panels, solar thermal panels and ASHPs have scored the best.

Due to the limited roof space, photovoltaic panels and ASHPs have been specified as they can provide higher CO2 savings compared to the solar thermal panels.

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Air Source Het Pump (ASHP) - Performance

The lifecycle of the proposed system is 25 years. To calculate the lifecycle cost of the ASHP, the maintenance of the system and cost of electricity to run the pumps will be included.

The communal ASHP has been estimated to have a CoP of 2.8 and it will cover 100% of the space heating demand and 80% of the hot water demand. The remaining 20% of the hot water demand will be covered by immersion heater. A thermal store will be specified to optimise the system's operations

The following table summarise the reduction in carbon emissions and the life cycle cost of the ASHP system compared to a gas boiler.

	Gas Boiler	Air Source Heat Pump
	Heating and hot water	Heating and hot water
Installation cost (£)	10,000	39,000
Maintenance and replacement cost (£)	12,000	4,000
Total (£)	22,000	43,000
Energy demand (kWh)	58,900	22,392
Cost of gas/electricity (p/kWh)	5.0	12.5
Annual operational cost (£)	2,945	2,800

It should be noted that the figures above are based on SAP modelling for CO2 compliance. Compliance models are not well suited to investment appraisals because they do not accurately estimate energy consumption. It is estimated that the lifecycle saving for ASHP will be greater than boiler under 'real-life' operating conditions and consumption.

Moreover, the servicing strategy has been proposed based on sustainability aspirations and compliance with GLA requirements, which is intended to supersede simple economic payback appraisals for purposes of energy strategies.

Cost Performance Criteria	Value
Extra Cost Over Life Cycle (£)	21,000
Predicted Annual Savings (£)	146
Payback Period (years)	143.5
Energy and Carbon Performance Criteria	Value
Predicted Annual Energy Saved (kWh/yr)	36.514
Annual Carbon Emissions Reductions (kg CO2/year) using SAP10.0 carbon factors	7,094
CO2 Emissions Reduction (%) with SAP10.0	41.8%

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Photovoltaic panels (PV) - Performance

A photovoltaic panel system of 7.0 kWp (20 panels of 350W each) has been specified for the whole development, a detailed summary of the lifecycle cost, revenue and payback for the photovoltaic panels is presented in this section.

The following drawing shows that there are approx.120 sqm of available roof area including circulation area that could be used to install photovoltaic modules with lack of shading. PV panels will be placed with 30° tilt, oriented south-east, covering approx. 40 m2 (2m2/panel for 20 panels) of the roof.

The lifecycle of the proposed high efficiency panels is 25 years. To calculate the lifecycle cost of the panels, the maintenance of the system and replacement cost will be included. The total costs for the proposed system's lifetime is shown in the table below.

Capital cost (£)	9,100
Maintenance cost (£)	1,800
Operational cost (£)	900
Total (£)	11,800
Cost of electricity (p/kWh)	12.5
Electricity generation (kWh/yr)	5,763
% of energy used on site	
Savings (£)	515
Summary	
Cost Performance Criteria	Value
Extra Cost Over Life Cycle (£)	11,800
Predicted Annual Savings (£)	515
Payback Period (years)	22.9
Energy and Carbon Performance Criteria	Value
Predicted Annual Energy Saved (kWh/yr)	5,763
Annual Carbon Emissions Reductions (kg CO_2/year) using SAP10.0 carbon factors	1,343
CO_2 Emissions Reduction (%) with SAP10.0	7.9%

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Conclusion

Summary

All flats and the refurbished house have been modelled for the purposes of the energy assessment. High energy efficiency performance building services have been used for these units in order to achieve the required carbon emission targets.

The scheme complies with the 2013 Building Regulations Part L and the minimum energy efficiency targets in the following documents have been followed:

- New build (Part L1A) – The actual building CO2 emissions rate (DER) is no greater than the notional building CO2 target emissions rate.
- Refurbishment (Part L1B) – Consequential improvements to refurbished areas have been made to ensure that the building complies with Part L, to the extent that such improvements are technically, functionally, and economically feasible.

In addition, the CO2 emissions of the scheme have been calculated using the SAP 10.0 carbon emission factors, and the scheme can achieve:

- An on-site CO2 reduction of 68.5% beyond Building Regulations achieved through energy efficiency measures and maximised of renewable technologies (Communal Air Source Heat Pumps and PV panels)
- The development achieves 18.8% CO2 improvement through energy efficiency measures, 'Be Lean' stage
- A further improvement of 49.7% CO2 has been achieved through renewable technologies 'Be Green' stage (Air Source Heat Pumps and PV panels)
- Overall, the scheme achieves an improvement of 68.5% through measures on-site
- Zero-carbon target can be achieved through a cash in lieu contribution to the borough's carbon offset fund. The carbon offset payment cost has been calculated as £15,210.

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Appendix A

Air quality impacts

To ensure that the air quality assessment is as robust as possible, the total gas and electricity consumption is shown in the table below.

Energy source	Total fuel consumption (residential) (MWh/year)
Grid electricity	48.5
Gas boilers (communal/individual)	0
Gas CHP	0
Connection to existing District Heating network	0
Other gas use (e.g. cookers)	0

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Appendix B

SAP files

The emission figures and details of the calculations and methodology used to determine the figures provided within the report can be found in the following pages:

- Baseline Refurbishment (GLA's Appendix 4) – DER from the DER SAP worksheet
- Baseline New-built – TER from the TER SAP worksheet
- Be Lean – DER from the Be Lean scenario DER SAP worksheet
- Be Green– DER from the Be Green scenario DER SAP worksheet

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Baseline Refurbishment (GLA's Appendix 4) – DER from the DER SAP worksheet

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House- H01-Notional

Address : West End Lane, LONDON, NW6 4NX

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	57.4	(1a)	x	2.1	(2a)	=	120.54	(3a)
Ground floor	53.06	(1b)	x	2.85	(2b)	=	151.22	(3b)
First floor	53.06	(1c)	x	3.08	(2c)	=	163.42	(3c)
Second floor	43.77	(1d)	x	2.26	(2d)	=	98.92	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	207.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	534.11	(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							4	x 10 =	40	(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) =	40	÷ (5) =	0.07	(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)	0.82	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.7	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling created by change of use

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.89	0.88	0.86	0.77	0.75	0.67	0.67	0.65	0.7	0.75	0.79	0.82

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(24d)

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

(25)m=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(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 Type 1			3.67	x 1.6	= 5.872			(26)
Doors Type 2			2.85	x 1.6	= 4.56			(26)
Doors Type 3			2.35	x 1	= 2.35			(26)
Windows Type 1			2.22	x1/[1/(1.6)+ 0.04]	= 3.34			(27)
Windows Type 2			1.13	x1/[1/(1.6)+ 0.04]	= 1.7			(27)
Windows Type 3			0.61	x1/[1/(1.6)+ 0.04]	= 0.92			(27)
Windows Type 4			2.25	x1/[1/(1.6)+ 0.04]	= 3.38			(27)
Windows Type 5			1.77	x1/[1/(1.6)+ 0.04]	= 2.66			(27)
Windows Type 6			1.31	x1/[1/(1.6)+ 0.04]	= 1.97			(27)
Windows Type 7			0.68	x1/[1/(1.6)+ 0.04]	= 1.02			(27)
Windows Type 8			2.69	x1/[1/(1.6)+ 0.04]	= 4.05			(27)
Windows Type 9			1.03	x1/[1/(1.6)+ 0.04]	= 1.55			(27)
Windows Type 10			2.9	x1/[1/(1.6)+ 0.04]	= 4.36			(27)
Rooflights			1.112034	x1/[1/(1.6) + 0.04]	= 1.779254			(27b)

DER WorkSheet: New dwelling created by change of use

Floor Type 1			57.4	x	0.55	=	31.57			(28)
Floor Type 2			53.06	x	0.55	=	29.183			(28)
Walls Type1	81.43	0	81.43	x	0.55	=	44.79			(29)
Walls Type2	15.31	6.41	8.9	x	0.28	=	2.49			(29)
Walls Type3	24.3	0	24.3	x	0.28	=	6.8			(29)
Walls Type4	101.44	33.57	67.87	x	0.55	=	37.33			(29)
Roof Type1	62.74	3.34	59.4	x	0.18	=	10.69			(30)
Roof Type2	10.96	0	10.96	x	0.18	=	1.97			(30)
Total area of elements, m²			406.64							(31)
Party wall			58.5	x	0	=	0			(32)

** 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) =	229.41	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39052.95	(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		61	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	290.41	(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=	158.56	155.82	153.14	140.55	138.2	127.23	127.23	125.2	131.45	138.2	142.96	147.94	(38)

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

(39)m=	448.96	446.23	443.55	430.96	428.6	417.63	417.63	415.6	421.86	428.6	433.37	438.35	

Average = Sum(39)$_{1…12}$ /12= 430.95 (39)

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

(40)m=	2.17	2.15	2.14	2.08	2.07	2.01	2.01	2	2.04	2.07	2.09	2.11

Average = Sum(40)$_{1…12}$ /12= 2.08 (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 3.01 (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) + 36 105.72 (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=	116.29	112.06	107.84	103.61	99.38	95.15	95.15	99.38	103.61	107.84	112.06	116.29

Total = Sum(44)$_{1…12}$ = 1268.65 (44)

DER WorkSheet: New dwelling created by change of use

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=	172.46	150.83	155.65	135.7	130.2	112.36	104.11	119.47	120.9	140.9	153.8	167.02	

Total = Sum(45)1...12 = 1663.4 (45)

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

(46)m=	25.87	22.63	23.35	20.35	19.53	16.85	15.62	17.92	18.14	21.13	23.07	25.05	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.96	49.32	50.64	46.92	48.49	50.64	49.32	50.96	49.32	50.96	(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=	223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98	(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=	223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98

Output from water heater (annual)1...12 2257.9 (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=	70.08	61.66	64.49	57.45	55.95	49.09	46.74	52.39	52.53	59.59	63.47	68.27	(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

DER WorkSheet: New dwelling created by change of use

(66)m=	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	42.12	37.41	30.42	23.03	17.22	14.53	15.7	20.41	27.4	34.79	40.6	43.29	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	377.92	381.84	371.96	350.92	324.37	299.41	282.73	278.81	288.69	309.73	336.29	361.25	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	(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=	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	(71)
Water heating gains (Table 5)													
(72)m=	94.2	91.75	86.68	79.79	75.21	68.18	62.82	70.41	72.96	80.09	88.15	91.76	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	585.4	582.18	560.24	524.91	487.96	453.29	432.43	440.8	460.22	495.78	536.21	567.47	(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	0.68	x	11.28	x	0.63	x	0.8	=	8.04	(75)
Northeast 0.9x	0.77	x	0.68	x	22.97	x	0.63	x	0.8	=	16.36	(75)
Northeast 0.9x	0.77	x	0.68	x	41.38	x	0.63	x	0.8	=	29.48	(75)
Northeast 0.9x	0.77	x	0.68	x	67.96	x	0.63	x	0.8	=	48.42	(75)
Northeast 0.9x	0.77	x	0.68	x	91.35	x	0.63	x	0.8	=	65.09	(75)
Northeast 0.9x	0.77	x	0.68	x	97.38	x	0.63	x	0.8	=	69.39	(75)
Northeast 0.9x	0.77	x	0.68	x	91.1	x	0.63	x	0.8	=	64.91	(75)
Northeast 0.9x	0.77	x	0.68	x	72.63	x	0.63	x	0.8	=	51.75	(75)
Northeast 0.9x	0.77	x	0.68	x	50.42	x	0.63	x	0.8	=	35.93	(75)
Northeast 0.9x	0.77	x	0.68	x	28.07	x	0.63	x	0.8	=	20	(75)
Northeast 0.9x	0.77	x	0.68	x	14.2	x	0.63	x	0.8	=	10.12	(75)
Northeast 0.9x	0.77	x	0.68	x	9.21	x	0.63	x	0.8	=	6.57	(75)
Southeast 0.9x	0.77	x	2.69	x	36.79	x	0.63	x	0.8	=	69.14	(77)
Southeast 0.9x	0.77	x	1.03	x	36.79	x	0.63	x	0.8	=	13.24	(77)
Southeast 0.9x	0.77	x	2.69	x	62.67	x	0.63	x	0.8	=	117.77	(77)
Southeast 0.9x	0.77	x	1.03	x	62.67	x	0.63	x	0.8	=	22.55	(77)
Southeast 0.9x	0.77	x	2.69	x	85.75	x	0.63	x	0.8	=	161.14	(77)
Southeast 0.9x	0.77	x	1.03	x	85.75	x	0.63	x	0.8	=	30.85	(77)
Southeast 0.9x	0.77	x	2.69	x	106.25	x	0.63	x	0.8	=	199.66	(77)
Southeast 0.9x	0.77	x	1.03	x	106.25	x	0.63	x	0.8	=	38.22	(77)
Southeast 0.9x	0.77	x	2.69	x	119.01	x	0.63	x	0.8	=	223.63	(77)

DER WorkSheet: New dwelling created by change of use

Southeast	0.9x	0.77	x	1.03	x	119.01	x	0.63	x	0.8	=	42.81	(77)
Southeast	0.9x	0.77	x	2.69	x	118.15	x	0.63	x	0.8	=	222.01	(77)
Southeast	0.9x	0.77	x	1.03	x	118.15	x	0.63	x	0.8	=	42.5	(77)
Southeast	0.9x	0.77	x	2.69	x	113.91	x	0.63	x	0.8	=	214.04	(77)
Southeast	0.9x	0.77	x	1.03	x	113.91	x	0.63	x	0.8	=	40.98	(77)
Southeast	0.9x	0.77	x	2.69	x	104.39	x	0.63	x	0.8	=	196.16	(77)
Southeast	0.9x	0.77	x	1.03	x	104.39	x	0.63	x	0.8	=	37.55	(77)
Southeast	0.9x	0.77	x	2.69	x	92.85	x	0.63	x	0.8	=	174.48	(77)
Southeast	0.9x	0.77	x	1.03	x	92.85	x	0.63	x	0.8	=	33.4	(77)
Southeast	0.9x	0.77	x	2.69	x	69.27	x	0.63	x	0.8	=	130.16	(77)
Southeast	0.9x	0.77	x	1.03	x	69.27	x	0.63	x	0.8	=	24.92	(77)
Southeast	0.9x	0.77	x	2.69	x	44.07	x	0.63	x	0.8	=	82.81	(77)
Southeast	0.9x	0.77	x	1.03	x	44.07	x	0.63	x	0.8	=	15.85	(77)
Southeast	0.9x	0.77	x	2.69	x	31.49	x	0.63	x	0.8	=	59.17	(77)
Southeast	0.9x	0.77	x	1.03	x	31.49	x	0.63	x	0.8	=	11.33	(77)
Southwest	0.9x	0.77	x	2.22	x	36.79		0.63	x	0.8	=	57.06	(79)
Southwest	0.9x	0.77	x	1.13	x	36.79		0.63	x	0.8	=	29.04	(79)
Southwest	0.9x	0.77	x	0.61	x	36.79		0.63	x	0.8	=	7.84	(79)
Southwest	0.9x	0.77	x	2.22	x	62.67		0.63	x	0.8	=	97.19	(79)
Southwest	0.9x	0.77	x	1.13	x	62.67		0.63	x	0.8	=	49.47	(79)
Southwest	0.9x	0.77	x	0.61	x	62.67		0.63	x	0.8	=	13.35	(79)
Southwest	0.9x	0.77	x	2.22	x	85.75		0.63	x	0.8	=	132.98	(79)
Southwest	0.9x	0.77	x	1.13	x	85.75		0.63	x	0.8	=	67.69	(79)
Southwest	0.9x	0.77	x	0.61	x	85.75		0.63	x	0.8	=	18.27	(79)
Southwest	0.9x	0.77	x	2.22	x	106.25		0.63	x	0.8	=	164.77	(79)
Southwest	0.9x	0.77	x	1.13	x	106.25		0.63	x	0.8	=	83.87	(79)
Southwest	0.9x	0.77	x	0.61	x	106.25		0.63	x	0.8	=	22.64	(79)
Southwest	0.9x	0.77	x	2.22	x	119.01		0.63	x	0.8	=	184.56	(79)
Southwest	0.9x	0.77	x	1.13	x	119.01		0.63	x	0.8	=	93.94	(79)
Southwest	0.9x	0.77	x	0.61	x	119.01		0.63	x	0.8	=	25.36	(79)
Southwest	0.9x	0.77	x	2.22	x	118.15		0.63	x	0.8	=	183.22	(79)
Southwest	0.9x	0.77	x	1.13	x	118.15		0.63	x	0.8	=	93.26	(79)
Southwest	0.9x	0.77	x	0.61	x	118.15		0.63	x	0.8	=	25.17	(79)
Southwest	0.9x	0.77	x	2.22	x	113.91		0.63	x	0.8	=	176.65	(79)
Southwest	0.9x	0.77	x	1.13	x	113.91		0.63	x	0.8	=	89.91	(79)
Southwest	0.9x	0.77	x	0.61	x	113.91		0.63	x	0.8	=	24.27	(79)
Southwest	0.9x	0.77	x	2.22	x	104.39		0.63	x	0.8	=	161.89	(79)
Southwest	0.9x	0.77	x	1.13	x	104.39		0.63	x	0.8	=	82.4	(79)
Southwest	0.9x	0.77	x	0.61	x	104.39		0.63	x	0.8	=	22.24	(79)
Southwest	0.9x	0.77	x	2.22	x	92.85		0.63	x	0.8	=	143.99	(79)
Southwest	0.9x	0.77	x	1.13	x	92.85		0.63	x	0.8	=	73.29	(79)

DER WorkSheet: New dwelling created by change of use

Southwest	0.9x	0.77	x	0.61	x	92.85		0.63	x	0.8	=	19.78	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27		0.63	x	0.8	=	107.42	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.63	x	0.8	=	54.68	(79)
Southwest	0.9x	0.77	x	0.61	x	69.27		0.63	x	0.8	=	14.76	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07		0.63	x	0.8	=	68.34	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.63	x	0.8	=	34.79	(79)
Southwest	0.9x	0.77	x	0.61	x	44.07		0.63	x	0.8	=	9.39	(79)
Southwest	0.9x	0.77	x	2.22	x	31.49		0.63	x	0.8	=	48.83	(79)
Southwest	0.9x	0.77	x	1.13	x	31.49		0.63	x	0.8	=	24.86	(79)
Southwest	0.9x	0.77	x	0.61	x	31.49		0.63	x	0.8	=	6.71	(79)
Northwest	0.9x	0.77	x	2.25	x	11.28	x	0.63	x	0.8	=	26.6	(81)
Northwest	0.9x	0.77	x	1.77	x	11.28	x	0.63	x	0.8	=	6.98	(81)
Northwest	0.9x	0.77	x	1.31	x	11.28	x	0.63	x	0.8	=	15.49	(81)
Northwest	0.9x	0.77	x	2.9	x	11.28	x	0.63	x	0.8	=	11.43	(81)
Northwest	0.9x	0.77	x	2.25	x	22.97	x	0.63	x	0.8	=	54.15	(81)
Northwest	0.9x	0.77	x	1.77	x	22.97	x	0.63	x	0.8	=	14.2	(81)
Northwest	0.9x	0.77	x	1.31	x	22.97	x	0.63	x	0.8	=	31.53	(81)
Northwest	0.9x	0.77	x	2.9	x	22.97	x	0.63	x	0.8	=	23.26	(81)
Northwest	0.9x	0.77	x	2.25	x	41.38	x	0.63	x	0.8	=	97.55	(81)
Northwest	0.9x	0.77	x	1.77	x	41.38	x	0.63	x	0.8	=	25.58	(81)
Northwest	0.9x	0.77	x	1.31	x	41.38	x	0.63	x	0.8	=	56.8	(81)
Northwest	0.9x	0.77	x	2.9	x	41.38	x	0.63	x	0.8	=	41.91	(81)
Northwest	0.9x	0.77	x	2.25	x	67.96	x	0.63	x	0.8	=	160.21	(81)
Northwest	0.9x	0.77	x	1.77	x	67.96	x	0.63	x	0.8	=	42.01	(81)
Northwest	0.9x	0.77	x	1.31	x	67.96	x	0.63	x	0.8	=	93.28	(81)
Northwest	0.9x	0.77	x	2.9	x	67.96	x	0.63	x	0.8	=	68.83	(81)
Northwest	0.9x	0.77	x	2.25	x	91.35	x	0.63	x	0.8	=	215.36	(81)
Northwest	0.9x	0.77	x	1.77	x	91.35	x	0.63	x	0.8	=	56.47	(81)
Northwest	0.9x	0.77	x	1.31	x	91.35	x	0.63	x	0.8	=	125.39	(81)
Northwest	0.9x	0.77	x	2.9	x	91.35	x	0.63	x	0.8	=	92.52	(81)
Northwest	0.9x	0.77	x	2.25	x	97.38	x	0.63	x	0.8	=	229.59	(81)
Northwest	0.9x	0.77	x	1.77	x	97.38	x	0.63	x	0.8	=	60.2	(81)
Northwest	0.9x	0.77	x	1.31	x	97.38	x	0.63	x	0.8	=	133.67	(81)
Northwest	0.9x	0.77	x	2.9	x	97.38	x	0.63	x	0.8	=	98.64	(81)
Northwest	0.9x	0.77	x	2.25	x	91.1	x	0.63	x	0.8	=	214.78	(81)
Northwest	0.9x	0.77	x	1.77	x	91.1	x	0.63	x	0.8	=	56.32	(81)
Northwest	0.9x	0.77	x	1.31	x	91.1	x	0.63	x	0.8	=	125.05	(81)
Northwest	0.9x	0.77	x	2.9	x	91.1	x	0.63	x	0.8	=	92.28	(81)
Northwest	0.9x	0.77	x	2.25	x	72.63	x	0.63	x	0.8	=	171.22	(81)
Northwest	0.9x	0.77	x	1.77	x	72.63	x	0.63	x	0.8	=	44.9	(81)
Northwest	0.9x	0.77	x	1.31	x	72.63	x	0.63	x	0.8	=	99.69	(81)

Northwest	0.9x	0.77	x	2.9	x	72.63	x	0.63	x	0.8	=	73.56	(81)
Northwest	0.9x	0.77	x	2.25	x	50.42	x	0.63	x	0.8	=	118.87	(81)
Northwest	0.9x	0.77	x	1.77	x	50.42	x	0.63	x	0.8	=	31.17	(81)
Northwest	0.9x	0.77	x	1.31	x	50.42	x	0.63	x	0.8	=	69.21	(81)
Northwest	0.9x	0.77	x	2.9	x	50.42	x	0.63	x	0.8	=	51.07	(81)
Northwest	0.9x	0.77	x	2.25	x	28.07	x	0.63	x	0.8	=	66.17	(81)
Northwest	0.9x	0.77	x	1.77	x	28.07	x	0.63	x	0.8	=	17.35	(81)
Northwest	0.9x	0.77	x	1.31	x	28.07	x	0.63	x	0.8	=	38.53	(81)
Northwest	0.9x	0.77	x	2.9	x	28.07	x	0.63	x	0.8	=	28.43	(81)
Northwest	0.9x	0.77	x	2.25	x	14.2	x	0.63	x	0.8	=	33.47	(81)
Northwest	0.9x	0.77	x	1.77	x	14.2	x	0.63	x	0.8	=	8.78	(81)
Northwest	0.9x	0.77	x	1.31	x	14.2	x	0.63	x	0.8	=	19.49	(81)
Northwest	0.9x	0.77	x	2.9	x	14.2	x	0.63	x	0.8	=	14.38	(81)
Northwest	0.9x	0.77	x	2.25	x	9.21	x	0.63	x	0.8	=	21.72	(81)
Northwest	0.9x	0.77	x	1.77	x	9.21	x	0.63	x	0.8	=	5.7	(81)
Northwest	0.9x	0.77	x	1.31	x	9.21	x	0.63	x	0.8	=	12.65	(81)
Northwest	0.9x	0.77	x	2.9	x	9.21	x	0.63	x	0.8	=	9.33	(81)
Rooflights	0.9x	1	x	1.11	x	37.03	x	0.55	x	0.8	=	48.92	(82)
Rooflights	0.9x	1	x	1.11	x	70.28	x	0.55	x	0.8	=	92.85	(82)
Rooflights	0.9x	1	x	1.11	x	111.87	x	0.55	x	0.8	=	147.79	(82)
Rooflights	0.9x	1	x	1.11	x	159.33	x	0.55	x	0.8	=	210.48	(82)
Rooflights	0.9x	1	x	1.11	x	193.3	x	0.55	x	0.8	=	255.37	(82)
Rooflights	0.9x	1	x	1.11	x	197.35	x	0.55	x	0.8	=	260.71	(82)
Rooflights	0.9x	1	x	1.11	x	188.08	x	0.55	x	0.8	=	248.47	(82)
Rooflights	0.9x	1	x	1.11	x	162.62	x	0.55	x	0.8	=	214.83	(82)
Rooflights	0.9x	1	x	1.11	x	128.66	x	0.55	x	0.8	=	169.98	(82)
Rooflights	0.9x	1	x	1.11	x	82.24	x	0.55	x	0.8	=	108.65	(82)
Rooflights	0.9x	1	x	1.11	x	45.75	x	0.55	x	0.8	=	60.44	(82)
Rooflights	0.9x	1	x	1.11	x	30.74	x	0.55	x	0.8	=	40.61	(82)

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

(83)m=	293.77	532.68	810.05	1132.4	1380.49	1418.39	1347.66	1156.2	921.17	611.06	357.86	247.47	(83)

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

(84)m=	879.17	1114.86	1370.28	1657.31	1868.45	1871.68	1780.08	1597	1381.39	1106.84	894.07	814.94	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.88	0.78	0.83	0.95	0.99	1	1	(86)

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

(87)m=	18.47	18.67	19.05	19.61	20.14	20.6	20.82	20.77	20.38	19.7	19.02	18.48	(87)

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

(88)m=	19.92	19.92	19.93	19.96	19.97	19.99	19.99	20	19.98	19.97	19.95	19.94	(88)

DER WorkSheet: New dwelling created by change of use

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

(89)m=	1	1	0.99	0.98	0.94	0.83	0.67	0.74	0.93	0.99	1	1	(89)

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

(90)m=	17.57	17.78	18.17	18.74	19.27	19.72	19.91	19.88	19.51	18.83	18.14	17.6	(90)

fLA = Living area ÷ (4) = 0.17 (91)

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

(92)m=	17.73	17.93	18.32	18.89	19.42	19.87	20.06	20.03	19.66	18.98	18.29	17.75	(92)

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

(93)m=	18.33	18.53	18.92	19.49	20.02	20.47	20.66	20.63	20.26	19.58	18.89	18.35	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.86	0.75	0.8	0.94	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	877.6	1110.51	1357.62	1616.59	1751.24	1607.02	1332.88	1282.9	1293.91	1092.85	891.35	813.84	(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=	6297.15	6084.02	5507.97	4564.13	3565.87	2452.29	1697.48	1757.79	2599.88	3849.15	5111.21	6201.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4032.15	3342.2	3087.86	2122.23	1350.08	0	0	0	0	2050.69	3038.3	4008.57	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 23032.07 (98)

Space heating requirement in kWh/m²/year 111.11 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	4032.15	3342.2	3087.86	2122.23	1350.08	0	0	0	0	2050.69	3038.3	4008.57	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	4465.28	3701.21	3419.56	2350.2	1495.11	0	0	0	0	2270.97	3364.67	4439.17	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 25506.17 (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)

DER WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98

Efficiency of water heater 81 (216)

(217)m=	89.76	89.73	89.65	89.48	89.09	81	81	81	81	89.42	89.65	89.77	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	248.91	219.4	230.45	206.77	202.99	196.64	188.4	210.02	210.14	214.55	226.55	242.82

Total = Sum(219a)$_{1...12}$ = 2597.64 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			25506.17	
Water heating fuel used			2597.64	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		39		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		39	(231)
Electricity for lighting			743.76	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			28886.58	(338)

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	=	5509.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	561.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6070.42	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	20.24	(267)
Electricity for lighting	(232) x	0.519	=	386.01	(268)
Total CO2, kg/year		sum of (265)…(271) =		6476.68	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		31.24	(273)
EI rating (section 14)				66	(274)

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Baseline New built – TER from the TER SAP worksheet

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-G01-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	81.64	(1a) x	2.7	(2a) =	220.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.64	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	220.43	(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) =	0.14	(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			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.34	x1/[1/(1.4)+ 0.04]		=	5.75			(27)
Windows Type 3			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 4			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Floor			81.64	x	0.13	=	10.6132			(28)
Walls Type1	79.62	16.14	63.48	x	0.18	=	11.43			(29)
Walls Type2	53.08	1.99	51.09	x	0.18	=	9.2			(29)
Roof Type1	4.85	0	4.85	x	0.13	=	0.63			(30)
Roof Type2	1.55	0	1.55	x	0.13	=	0.2			(30)
Total area of elements, m²			220.74							(31)
Party ceiling			75.24							(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) = 55.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 30206.1 (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 16.41 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

TER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	71.86	(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=	42.74	42.49	42.25	41.11	40.9	39.91	39.91	39.72	40.29	40.9	41.33	41.78	(38)

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

(39)m=	114.6	114.35	114.11	112.97	112.76	111.77	111.77	111.58	112.15	112.76	113.19	113.64	

Average = Sum(39)1…12 /12= 112.97 (39)

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

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

Average = Sum(40)1…12 /12= 1.38 (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 93.41 (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=	102.76	99.02	95.28	91.55	87.81	84.07	84.07	87.81	91.55	95.28	99.02	102.76	

Total = Sum(44)1…12 = 1120.97 (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=	152.38	133.28	137.53	119.9	115.05	99.28	92	105.57	106.83	124.5	135.9	147.58	

Total = Sum(45)1…12 = 1469.77 (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	15.83	16.02	18.67	20.38	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)
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=	50.96	45.58	48.56	45.15	44.75	41.46	42.84	44.75	45.15	48.56	48.83	50.96	(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=	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53	(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=	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53

Output from water heater (annual)$_{1...12}$ | 2027.3 | (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=	63.41	55.71	57.87	51.15	49.44	43.37	41.3	46.29	46.81	53.53	57.39	61.81	(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=	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	(66)

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

(67)m=	20.03	17.79	14.47	10.95	8.19	6.91	7.47	9.71	13.03	16.55	19.31	20.59	(67)

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

(68)m=	222.83	225.15	219.32	206.91	191.26	176.54	166.71	164.39	170.22	182.63	198.28	213	(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=	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	(71)

Water heating gains (Table 5)

(72)m=	85.23	82.9	77.78	71.05	66.45	60.24	55.51	62.21	65.01	71.95	79.71	83.08	(72)

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

(73)m=	391.49	389.24	374.97	352.31	329.29	307.09	293.08	299.72	311.66	334.52	360.71	380.06	(73)

6. Solar gains:

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

TER 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	0.77	x	1.65	x	11.28	x	0.63	x	0.7	=	11.38	(75)
Northeast	0.9x	0.77	x	1.65	x	22.97	x	0.63	x	0.7	=	23.16	(75)
Northeast	0.9x	0.77	x	1.65	x	41.38	x	0.63	x	0.7	=	41.73	(75)
Northeast	0.9x	0.77	x	1.65	x	67.96	x	0.63	x	0.7	=	68.54	(75)
Northeast	0.9x	0.77	x	1.65	x	91.35	x	0.63	x	0.7	=	92.12	(75)
Northeast	0.9x	0.77	x	1.65	x	97.38	x	0.63	x	0.7	=	98.21	(75)
Northeast	0.9x	0.77	x	1.65	x	91.1	x	0.63	x	0.7	=	91.88	(75)
Northeast	0.9x	0.77	x	1.65	x	72.63	x	0.63	x	0.7	=	73.25	(75)
Northeast	0.9x	0.77	x	1.65	x	50.42	x	0.63	x	0.7	=	50.85	(75)
Northeast	0.9x	0.77	x	1.65	x	28.07	x	0.63	x	0.7	=	28.31	(75)
Northeast	0.9x	0.77	x	1.65	x	14.2	x	0.63	x	0.7	=	14.32	(75)
Northeast	0.9x	0.77	x	1.65	x	9.21	x	0.63	x	0.7	=	9.29	(75)
Southeast	0.9x	0.77	x	5.76	x	36.79	x	0.63	x	0.7	=	64.77	(77)
Southeast	0.9x	0.77	x	5.76	x	62.67	x	0.63	x	0.7	=	110.33	(77)
Southeast	0.9x	0.77	x	5.76	x	85.75	x	0.63	x	0.7	=	150.95	(77)
Southeast	0.9x	0.77	x	5.76	x	106.25	x	0.63	x	0.7	=	187.04	(77)
Southeast	0.9x	0.77	x	5.76	x	119.01	x	0.63	x	0.7	=	209.5	(77)
Southeast	0.9x	0.77	x	5.76	x	118.15	x	0.63	x	0.7	=	207.98	(77)
Southeast	0.9x	0.77	x	5.76	x	113.91	x	0.63	x	0.7	=	200.52	(77)
Southeast	0.9x	0.77	x	5.76	x	104.39	x	0.63	x	0.7	=	183.76	(77)
Southeast	0.9x	0.77	x	5.76	x	92.85	x	0.63	x	0.7	=	163.45	(77)
Southeast	0.9x	0.77	x	5.76	x	69.27	x	0.63	x	0.7	=	121.93	(77)
Southeast	0.9x	0.77	x	5.76	x	44.07	x	0.63	x	0.7	=	77.58	(77)
Southeast	0.9x	0.77	x	5.76	x	31.49	x	0.63	x	0.7	=	55.43	(77)
Southwest	0.9x	0.77	x	1.37	x	36.79		0.63	x	0.7	=	30.81	(79)
Southwest	0.9x	0.77	x	4.34	x	36.79		0.63	x	0.7	=	48.8	(79)
Southwest	0.9x	0.77	x	1.37	x	62.67		0.63	x	0.7	=	52.48	(79)
Southwest	0.9x	0.77	x	4.34	x	62.67		0.63	x	0.7	=	83.13	(79)
Southwest	0.9x	0.77	x	1.37	x	85.75		0.63	x	0.7	=	71.81	(79)
Southwest	0.9x	0.77	x	4.34	x	85.75		0.63	x	0.7	=	113.74	(79)
Southwest	0.9x	0.77	x	1.37	x	106.25		0.63	x	0.7	=	88.97	(79)
Southwest	0.9x	0.77	x	4.34	x	106.25		0.63	x	0.7	=	140.93	(79)
Southwest	0.9x	0.77	x	1.37	x	119.01		0.63	x	0.7	=	99.66	(79)
Southwest	0.9x	0.77	x	4.34	x	119.01		0.63	x	0.7	=	157.85	(79)
Southwest	0.9x	0.77	x	1.37	x	118.15		0.63	x	0.7	=	98.94	(79)
Southwest	0.9x	0.77	x	4.34	x	118.15		0.63	x	0.7	=	156.71	(79)
Southwest	0.9x	0.77	x	1.37	x	113.91		0.63	x	0.7	=	95.39	(79)
Southwest	0.9x	0.77	x	4.34	x	113.91		0.63	x	0.7	=	151.08	(79)
Southwest	0.9x	0.77	x	1.37	x	104.39		0.63	x	0.7	=	87.41	(79)

Southwest	0.9x	0.77	x	4.34	x	104.39	0.63	x	0.7	=	138.46	(79)
Southwest	0.9x	0.77	x	1.37	x	92.85	0.63	x	0.7	=	77.75	(79)
Southwest	0.9x	0.77	x	4.34	x	92.85	0.63	x	0.7	=	123.16	(79)
Southwest	0.9x	0.77	x	1.37	x	69.27	0.63	x	0.7	=	58	(79)
Southwest	0.9x	0.77	x	4.34	x	69.27	0.63	x	0.7	=	91.87	(79)
Southwest	0.9x	0.77	x	1.37	x	44.07	0.63	x	0.7	=	36.9	(79)
Southwest	0.9x	0.77	x	4.34	x	44.07	0.63	x	0.7	=	58.45	(79)
Southwest	0.9x	0.77	x	1.37	x	31.49	0.63	x	0.7	=	26.37	(79)
Southwest	0.9x	0.77	x	4.34	x	31.49	0.63	x	0.7	=	41.76	(79)

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

(83)m=	155.76	269.1	378.23	485.47	559.13	561.84	538.87	482.88	415.21	300.12	187.25	132.85	(83)

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

(84)m=	547.25	658.33	753.2	837.79	888.42	868.94	831.95	782.6	726.87	634.64	547.96	512.92	(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	0.87	0.73	0.57	0.62	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=	19.5	19.69	19.99	20.37	20.7	20.91	20.98	20.97	20.82	20.38	19.87	19.46	(87)

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

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

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

(89)m=	1	0.99	0.97	0.93	0.82	0.62	0.42	0.47	0.76	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=	17.78	18.07	18.51	19.05	19.49	19.73	19.78	19.78	19.64	19.08	18.33	17.74	(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	18.36	18.62	19.01	19.49	19.89	20.12	20.18	20.18	20.04	19.52	18.85	18.32	(92)

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

(93)m=	18.36	18.62	19.01	19.49	19.89	20.12	20.18	20.18	20.04	19.52	18.85	18.32	(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	0.83	0.66	0.47	0.52	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.75	649.15	729.81	775.13	736.3	569.88	391.71	407.97	564.4	600.11	541.02	510.4	(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=	1611.24	1568.73	1427.2	1196.83	924.04	617.43	400.3	421.3	665.88	1005.56	1329.77	1604.34	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	794.21	617.95	518.85	303.63	139.68	0	0	0	0	301.65	567.9	813.89

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4057.76 (98)

Space heating requirement in kWh/m²/year 49.7 (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		93.4	(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)	794.21	617.95	518.85	303.63	139.68	0	0	0	0	301.65	567.9	813.89	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	850.33	661.62	555.52	325.08	149.55	0	0	0	0	322.97	608.03	871.41	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4344.5 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53

Efficiency of water heater 80.3 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(217)m=	88.14	87.92	87.49	86.57	84.71	80.3	80.3	80.3	80.3	86.44	87.69	88.22

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	230.7	203.43	212.68	190.66	188.63	175.27	167.92	187.19	189.26	200.21	210.65	225.03

Total = Sum(219a)$_{1...12}$ = 2381.63 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4344.5	
Water heating fuel used			2381.63	
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			353.75	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7154.88	(338)

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

TER WorkSheet: New dwelling design stage

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	938.41	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	514.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1452.84	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	183.6	(268)
Total CO2, kg/year			sum of (265)…(271) =		1675.36	(272)

TER = 20.52 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-101-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	79.31	(1a)	x	2.63	(2a)	=	208.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79.31	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	208.59	(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) =	0.14	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.16	x1/[1/(1.4)+ 0.04]		=	1.54			(27)
Windows Type 2			0.76	x1/[1/(1.4)+ 0.04]		=	1.01			(27)
Windows Type 3			4.92	x1/[1/(1.4)+ 0.04]		=	6.52			(27)
Windows Type 4			3.7	x1/[1/(1.4)+ 0.04]		=	4.91			(27)
Windows Type 5			3.53	x1/[1/(1.4)+ 0.04]		=	4.68			(27)
Rooflights			2.597236	x1/[1/(1.7) + 0.04]		=	4.415301			(27b)
Floor			55.4	x	0.13	=	7.202			(28)
Walls Type1	70.84	15.23	55.61	x	0.18	=	10.01			(29)
Walls Type2	27.91	1.99	25.92	x	0.18	=	4.67			(29)
Roof Type1	5.84	2.6	3.24	x	0.13	=	0.42			(30)
Roof Type2	0.17	0	0.17	x	0.13	=	0.02			(30)
Total area of elements, m²			160.16							(31)
Party wall			17.81	x	0	=	0			(32)
Party floor			23.91							(32a)
Party ceiling			70.27							(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) = 48.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 25946.71 (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 | 20.48 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = | 69.12 | (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=	40.69	40.44	40.2	39.08	38.87	37.9	37.9	37.72	38.27	38.87	39.3	39.74	(38)

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

(39)m=	109.8	109.56	109.32	108.2	107.99	107.01	107.01	106.83	107.39	107.99	108.41	108.86	

Average = Sum(39)$_{1…12}$ /12= | 108.2 | (39)

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

(40)m=	1.38	1.38	1.38	1.36	1.36	1.35	1.35	1.35	1.35	1.36	1.37	1.37	

Average = Sum(40)$_{1…12}$ /12= | 1.36 | (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 | 2.45 | (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 | 92.38 | (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=	101.62	97.92	94.23	90.53	86.84	83.14	83.14	86.84	90.53	94.23	97.92	101.62	

Total = Sum(44)$_{1…12}$ = | 1108.55 | (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=	150.69	131.8	136	118.57	113.77	98.18	90.98	104.4	105.64	123.12	134.39	145.94	

Total = Sum(45)$_{1…12}$ = | 1453.48 | (45)

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

(46)m=	22.6	19.77	20.4	17.79	17.07	14.73	13.65	15.66	15.85	18.47	20.16	21.89	(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=	50.96	45.07	48.02	44.65	44.25	41	42.37	44.25	44.65	48.02	48.29	50.96	(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=	201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9	(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=	201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9	

Output from water heater (annual)$_{1...12}$ | 2005.95 | (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=	62.85	55.09	57.23	50.59	48.89	42.89	40.84	45.77	46.29	52.94	56.76	61.26	(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=	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.43	17.26	14.04	10.63	7.94	6.71	7.25	9.42	12.64	16.05	18.74	19.97	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	217.99	220.25	214.55	202.42	187.1	172.7	163.08	160.82	166.52	178.66	193.98	208.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	(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=	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	(71)
Water heating gains (Table 5)													
(72)m=	84.47	81.98	76.92	70.26	65.72	59.58	54.89	61.52	64.29	71.16	78.83	82.35	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	384.64	382.24	368.25	346.05	323.5	301.73	287.97	294.51	306.2	328.61	354.29	373.44	(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	0.76	x	11.28	x	0.63	x	0.7	=	2.62	(75)
Northeast	0.9x	0.77	x	0.76	x	22.97	x	0.63	x	0.7	=	5.33	(75)
Northeast	0.9x	0.77	x	0.76	x	41.38	x	0.63	x	0.7	=	9.61	(75)
Northeast	0.9x	0.77	x	0.76	x	67.96	x	0.63	x	0.7	=	15.78	(75)
Northeast	0.9x	0.77	x	0.76	x	91.35	x	0.63	x	0.7	=	21.22	(75)
Northeast	0.9x	0.77	x	0.76	x	97.38	x	0.63	x	0.7	=	22.62	(75)
Northeast	0.9x	0.77	x	0.76	x	91.1	x	0.63	x	0.7	=	21.16	(75)
Northeast	0.9x	0.77	x	0.76	x	72.63	x	0.63	x	0.7	=	16.87	(75)
Northeast	0.9x	0.77	x	0.76	x	50.42	x	0.63	x	0.7	=	11.71	(75)
Northeast	0.9x	0.77	x	0.76	x	28.07	x	0.63	x	0.7	=	6.52	(75)
Northeast	0.9x	0.77	x	0.76	x	14.2	x	0.63	x	0.7	=	3.3	(75)
Northeast	0.9x	0.77	x	0.76	x	9.21	x	0.63	x	0.7	=	2.14	(75)
Southeast	0.9x	0.77	x	4.92	x	36.79	x	0.63	x	0.7	=	55.32	(77)
Southeast	0.9x	0.77	x	4.92	x	62.67	x	0.63	x	0.7	=	94.24	(77)
Southeast	0.9x	0.77	x	4.92	x	85.75	x	0.63	x	0.7	=	128.94	(77)
Southeast	0.9x	0.77	x	4.92	x	106.25	x	0.63	x	0.7	=	159.76	(77)
Southeast	0.9x	0.77	x	4.92	x	119.01	x	0.63	x	0.7	=	178.95	(77)
Southeast	0.9x	0.77	x	4.92	x	118.15	x	0.63	x	0.7	=	177.65	(77)
Southeast	0.9x	0.77	x	4.92	x	113.91	x	0.63	x	0.7	=	171.28	(77)
Southeast	0.9x	0.77	x	4.92	x	104.39	x	0.63	x	0.7	=	156.96	(77)
Southeast	0.9x	0.77	x	4.92	x	92.85	x	0.63	x	0.7	=	139.61	(77)
Southeast	0.9x	0.77	x	4.92	x	69.27	x	0.63	x	0.7	=	104.15	(77)
Southeast	0.9x	0.77	x	4.92	x	44.07	x	0.63	x	0.7	=	66.27	(77)
Southeast	0.9x	0.77	x	4.92	x	31.49	x	0.63	x	0.7	=	47.35	(77)
Southwest	0.9x	0.77	x	3.53	x	36.79		0.63	x	0.7	=	39.69	(79)
Southwest	0.9x	0.77	x	3.53	x	62.67		0.63	x	0.7	=	67.61	(79)
Southwest	0.9x	0.77	x	3.53	x	85.75		0.63	x	0.7	=	92.51	(79)
Southwest	0.9x	0.77	x	3.53	x	106.25		0.63	x	0.7	=	114.63	(79)
Southwest	0.9x	0.77	x	3.53	x	119.01		0.63	x	0.7	=	128.39	(79)
Southwest	0.9x	0.77	x	3.53	x	118.15		0.63	x	0.7	=	127.46	(79)
Southwest	0.9x	0.77	x	3.53	x	113.91		0.63	x	0.7	=	122.89	(79)
Southwest	0.9x	0.77	x	3.53	x	104.39		0.63	x	0.7	=	112.62	(79)
Southwest	0.9x	0.77	x	3.53	x	92.85		0.63	x	0.7	=	100.17	(79)
Southwest	0.9x	0.77	x	3.53	x	69.27		0.63	x	0.7	=	74.73	(79)
Southwest	0.9x	0.77	x	3.53	x	44.07		0.63	x	0.7	=	47.54	(79)
Southwest	0.9x	0.77	x	3.53	x	31.49		0.63	x	0.7	=	33.97	(79)
Northwest	0.9x	0.77	x	1.16	x	11.28	x	0.63	x	0.7	=	8	(81)
Northwest	0.9x	0.77	x	3.7	x	11.28	x	0.63	x	0.7	=	12.76	(81)
Northwest	0.9x	0.77	x	1.16	x	22.97	x	0.63	x	0.7	=	16.28	(81)

Northwest 0.9x	0.77	x	3.7	x	22.97	x	0.63	x	0.7	=	25.97	(81)
Northwest 0.9x	0.77	x	1.16	x	41.38	x	0.63	x	0.7	=	29.34	(81)
Northwest 0.9x	0.77	x	3.7	x	41.38	x	0.63	x	0.7	=	46.79	(81)
Northwest 0.9x	0.77	x	1.16	x	67.96	x	0.63	x	0.7	=	48.18	(81)
Northwest 0.9x	0.77	x	3.7	x	67.96	x	0.63	x	0.7	=	76.84	(81)
Northwest 0.9x	0.77	x	1.16	x	91.35	x	0.63	x	0.7	=	64.77	(81)
Northwest 0.9x	0.77	x	3.7	x	91.35	x	0.63	x	0.7	=	103.29	(81)
Northwest 0.9x	0.77	x	1.16	x	97.38	x	0.63	x	0.7	=	69.05	(81)
Northwest 0.9x	0.77	x	3.7	x	97.38	x	0.63	x	0.7	=	110.12	(81)
Northwest 0.9x	0.77	x	1.16	x	91.1	x	0.63	x	0.7	=	64.59	(81)
Northwest 0.9x	0.77	x	3.7	x	91.1	x	0.63	x	0.7	=	103.01	(81)
Northwest 0.9x	0.77	x	1.16	x	72.63	x	0.63	x	0.7	=	51.49	(81)
Northwest 0.9x	0.77	x	3.7	x	72.63	x	0.63	x	0.7	=	82.12	(81)
Northwest 0.9x	0.77	x	1.16	x	50.42	x	0.63	x	0.7	=	35.75	(81)
Northwest 0.9x	0.77	x	3.7	x	50.42	x	0.63	x	0.7	=	57.01	(81)
Northwest 0.9x	0.77	x	1.16	x	28.07	x	0.63	x	0.7	=	19.9	(81)
Northwest 0.9x	0.77	x	3.7	x	28.07	x	0.63	x	0.7	=	31.74	(81)
Northwest 0.9x	0.77	x	1.16	x	14.2	x	0.63	x	0.7	=	10.07	(81)
Northwest 0.9x	0.77	x	3.7	x	14.2	x	0.63	x	0.7	=	16.05	(81)
Northwest 0.9x	0.77	x	1.16	x	9.21	x	0.63	x	0.7	=	6.53	(81)
Northwest 0.9x	0.77	x	3.7	x	9.21	x	0.63	x	0.7	=	10.42	(81)
Rooflights 0.9x	1	x	2.6	x	18.07	x	0.63	x	0.7	=	18.63	(82)
Rooflights 0.9x	1	x	2.6	x	37.96	x	0.63	x	0.7	=	39.13	(82)
Rooflights 0.9x	1	x	2.6	x	71.02	x	0.63	x	0.7	=	73.21	(82)
Rooflights 0.9x	1	x	2.6	x	119.98	x	0.63	x	0.7	=	123.68	(82)
Rooflights 0.9x	1	x	2.6	x	163.58	x	0.63	x	0.7	=	168.63	(82)
Rooflights 0.9x	1	x	2.6	x	175.24	x	0.63	x	0.7	=	180.65	(82)
Rooflights 0.9x	1	x	2.6	x	163.61	x	0.63	x	0.7	=	168.65	(82)
Rooflights 0.9x	1	x	2.6	x	129.11	x	0.63	x	0.7	=	133.1	(82)
Rooflights 0.9x	1	x	2.6	x	87.66	x	0.63	x	0.7	=	90.37	(82)
Rooflights 0.9x	1	x	2.6	x	47.1	x	0.63	x	0.7	=	48.55	(82)
Rooflights 0.9x	1	x	2.6	x	22.95	x	0.63	x	0.7	=	23.66	(82)
Rooflights 0.9x	1	x	2.6	x	14.62	x	0.63	x	0.7	=	15.07	(82)

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

(83)m=	137.02	248.57	380.4	538.88	665.24	687.55	651.58	553.16	434.63	285.59	166.89	115.48	(83)

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

(84)m=	521.67	630.81	748.65	884.93	988.74	989.28	939.55	847.68	740.83	614.2	521.17	488.92	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.82	0.64	0.49	0.56	0.82	0.97	0.99	1	(86)

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

(87)m=	19.51	19.71	20.03	20.45	20.78	20.95	20.99	20.98	20.84	20.4	19.87	19.47	(87)

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

(88)m=	19.78	19.78	19.78	19.79	19.79	19.8	19.8	19.8	19.8	19.79	19.79	19.78	(88)

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

(89)m=	1	0.99	0.97	0.91	0.76	0.54	0.36	0.42	0.73	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=	17.81	18.1	18.57	19.17	19.59	19.77	19.8	19.8	19.68	19.11	18.36	17.77	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	18.4	18.66	19.08	19.61	20	20.18	20.21	20.2	20.08	19.55	18.88	18.36	(92)

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

(93)m=	18.4	18.66	19.08	19.61	20	20.18	20.21	20.2	20.08	19.55	18.88	18.36	(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	0.77	0.58	0.41	0.47	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	518.59	622.45	723.6	801.5	764.19	569.78	381.81	398.22	557.97	580.92	515.08	486.71	(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=	1548.17	1507.42	1375.11	1158.99	896.56	596.71	386.27	406.49	642.49	967.04	1277.19	1541.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	766.01	594.7	484.72	257.39	98.49	0	0	0	0	287.27	548.72	784.63	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3821.93 (98)

Space heating requirement in kWh/m²/year 48.19 (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		93.4	(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)													
	766.01	594.7	484.72	257.39	98.49	0	0	0	0	287.27	548.72	784.63	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	820.13	636.72	518.98	275.58	105.45	0	0	0	0	307.57	587.5	840.07	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4092 (211)

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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)

201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9

Efficiency of water heater 80.3 (216)

(217)m=	88.09	87.87	87.38	86.19	83.9	80.3	80.3	80.3	80.3	86.35	87.65	88.18	(217)

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

(219)m=	228.92	201.29	210.61	189.36	188.35	173.32	166.06	185.11	187.16	198.2	208.43	223.3

Total = Sum(219a)$_{1...12}$ = 2360.11 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4092	
Water heating fuel used			2360.11	
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			343.21	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6870.33	(338)

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	=	883.87	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	509.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1393.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	178.13	(268)
Total CO2, kg/year		sum of (265)…(271) =		1610.71	(272)

TER = 20.31 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-102-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

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

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.18	=	8.44			(29)
Walls Type2	22.49	1.99	20.5	x	0.18	=	3.69			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 25.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (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 5.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.65 (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

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(38)m=	26.63	26.47	26.31	25.56	25.43	24.78	24.78	24.66	25.03	25.43	25.71	26	(38)

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

(39)m=	58.27	58.11	57.95	57.21	57.07	56.42	56.42	56.3	56.67	57.07	57.35	57.65	

Average = $Sum(39)_{1...12}$ /12= 57.21 (39)

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

(40)m=	1.16	1.15	1.15	1.13	1.13	1.12	1.12	1.12	1.12	1.13	1.14	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.95	279.74	269.52	253.5	237.54	221.91	211.96	217.29	225.65	241.84	260.34	274.06	(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	4.65	x	11.28	x	0.63	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.63	x	0.7	=	5.31	(75)

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Northeast	0.9x	0.77	x	4.65	x	22.97	x	0.63	x	0.7	=	32.64	(75)
Northeast	0.9x	0.77	x	1.54	x	22.97	x	0.63	x	0.7	=	10.81	(75)
Northeast	0.9x	0.77	x	4.65	x	41.38	x	0.63	x	0.7	=	58.8	(75)
Northeast	0.9x	0.77	x	1.54	x	41.38	x	0.63	x	0.7	=	19.47	(75)
Northeast	0.9x	0.77	x	4.65	x	67.96	x	0.63	x	0.7	=	96.57	(75)
Northeast	0.9x	0.77	x	1.54	x	67.96	x	0.63	x	0.7	=	31.98	(75)
Northeast	0.9x	0.77	x	4.65	x	91.35	x	0.63	x	0.7	=	129.81	(75)
Northeast	0.9x	0.77	x	1.54	x	91.35	x	0.63	x	0.7	=	42.99	(75)
Northeast	0.9x	0.77	x	4.65	x	97.38	x	0.63	x	0.7	=	138.39	(75)
Northeast	0.9x	0.77	x	1.54	x	97.38	x	0.63	x	0.7	=	45.83	(75)
Northeast	0.9x	0.77	x	4.65	x	91.1	x	0.63	x	0.7	=	129.46	(75)
Northeast	0.9x	0.77	x	1.54	x	91.1	x	0.63	x	0.7	=	42.88	(75)
Northeast	0.9x	0.77	x	4.65	x	72.63	x	0.63	x	0.7	=	103.21	(75)
Northeast	0.9x	0.77	x	1.54	x	72.63	x	0.63	x	0.7	=	34.18	(75)
Northeast	0.9x	0.77	x	4.65	x	50.42	x	0.63	x	0.7	=	71.65	(75)
Northeast	0.9x	0.77	x	1.54	x	50.42	x	0.63	x	0.7	=	23.73	(75)
Northeast	0.9x	0.77	x	4.65	x	28.07	x	0.63	x	0.7	=	39.89	(75)
Northeast	0.9x	0.77	x	1.54	x	28.07	x	0.63	x	0.7	=	13.21	(75)
Northeast	0.9x	0.77	x	4.65	x	14.2	x	0.63	x	0.7	=	20.18	(75)
Northeast	0.9x	0.77	x	1.54	x	14.2	x	0.63	x	0.7	=	6.68	(75)
Northeast	0.9x	0.77	x	4.65	x	9.21	x	0.63	x	0.7	=	13.09	(75)
Northeast	0.9x	0.77	x	1.54	x	9.21	x	0.63	x	0.7	=	4.34	(75)
Southwest	0.9x	0.77	x	1.37	x	36.79		0.63	x	0.7	=	30.81	(79)
Southwest	0.9x	0.77	x	1.37	x	62.67		0.63	x	0.7	=	52.48	(79)
Southwest	0.9x	0.77	x	1.37	x	85.75		0.63	x	0.7	=	71.81	(79)
Southwest	0.9x	0.77	x	1.37	x	106.25		0.63	x	0.7	=	88.97	(79)
Southwest	0.9x	0.77	x	1.37	x	119.01		0.63	x	0.7	=	99.66	(79)
Southwest	0.9x	0.77	x	1.37	x	118.15		0.63	x	0.7	=	98.94	(79)
Southwest	0.9x	0.77	x	1.37	x	113.91		0.63	x	0.7	=	95.39	(79)
Southwest	0.9x	0.77	x	1.37	x	104.39		0.63	x	0.7	=	87.41	(79)
Southwest	0.9x	0.77	x	1.37	x	92.85		0.63	x	0.7	=	77.75	(79)
Southwest	0.9x	0.77	x	1.37	x	69.27		0.63	x	0.7	=	58	(79)
Southwest	0.9x	0.77	x	1.37	x	44.07		0.63	x	0.7	=	36.9	(79)
Southwest	0.9x	0.77	x	1.37	x	31.49		0.63	x	0.7	=	26.37	(79)

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

(83)m=	52.15	95.93	150.09	217.53	272.46	283.16	267.73	224.81	173.14	111.1	63.76	43.8	(83)

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

(84)m=	334.1	375.67	419.61	471.03	510	505.07	479.68	442.1	398.79	352.94	324.1	317.86	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	0.99	0.98	0.95	0.85	0.67	0.51	0.57	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=	19.81	19.95	20.2	20.54	20.82	20.96	20.99	20.99	20.89	20.53	20.11	19.79	(87)

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

(88)m=	19.96	19.96	19.96	19.97	19.98	19.99	19.99	19.99	19.98	19.98	19.97	19.97	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.4	0.45	0.75	0.96	0.99	1	(89)

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

(90)m=	18.38	18.59	18.95	19.44	19.8	19.96	19.98	19.98	19.89	19.43	18.83	18.35	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.16	19.33	19.63	20.04	20.36	20.5	20.53	20.53	20.43	20.03	19.53	19.13	(92)

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

(93)m=	19.16	19.33	19.63	20.04	20.36	20.5	20.53	20.53	20.43	20.03	19.53	19.13	(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	0.98	0.93	0.82	0.63	0.46	0.52	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.35	371.95	409.92	439.6	419.34	318.66	219.57	228.35	314.87	337.59	320.82	316.55	(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=	865.71	838.62	761.17	637.35	494.01	333.15	221.86	232.46	358.9	538.22	712.81	860.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	396.82	313.6	261.33	142.38	55.55	0	0	0	0	149.26	282.23	404.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2006.02 (98)

Space heating requirement in kWh/m²/year 39.77 (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		93.4	(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)													
	396.82	313.6	261.33	142.38	55.55	0	0	0	0	149.26	282.23	404.85	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	424.86	335.76	279.79	152.44	59.48	0	0	0	0	159.81	302.17	433.46	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2147.77 (211)

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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)

	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77		
Efficiency of water heater													80.3	(216)
(217)m=	87.2	86.98	86.46	85.24	83.12	80.3	80.3	80.3	80.3	85.24	86.66	87.29		(217)

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

(219)m=	187.63	164.32	171.99	154.72	153.63	140.06	134.18	149.58	151.24	162.22	170.35	183.03		
									Total = Sum(219a)$_{1...12}$ =				1922.96	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2147.77	
Water heating fuel used		1922.96	
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		239.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4384.98	(338)

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	=	463.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	415.36	(264)
Space and water heating	(261) + (262) + (263) + (264) =			879.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1042.37	(272)

TER = 20.67 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-201-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		191.81	(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) =	0.16	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.18	=	10.72			(29)
Walls Type2	27.91	1.99	25.92	x	0.18	=	4.67			(29)
Total area of elements, m²			103.17							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(32a)
Party ceiling			71.04							(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) = 38.23 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 8.13 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.36 (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=	37.79	37.55	37.32	36.22	36.01	35.06	35.06	34.88	35.42	36.01	36.43	36.86	(38)

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

(39)m=	84.14	83.91	83.67	82.57	82.37	81.41	81.41	81.24	81.78	82.37	82.78	83.22	

Average = $Sum(39)_{1...12}$ /12= 82.57 (39)

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

(40)m=	1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.17	1.17

Average = $Sum(40)_{1...12}$ /12= 1.16 (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 2.27 (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 88.14 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95

Total = $Sum(44)_{1...12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24

Total = $Sum(45)_{1...12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

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

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

(61)m=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1...12}$ — 1915.45 (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.81	15.82	12.86	9.74	7.28	6.15	6.64	8.63	11.58	14.71	17.17	18.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)
Water heating gains (Table 5)													
(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.16	348.1	(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)

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Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.63	x	0.7	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.63	x	0.7	=	11.38	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.63	x	0.7	=	18.69	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.63	x	0.7	=	25.12	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.63	x	0.7	=	26.79	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.63	x	0.7	=	25.06	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.63	x	0.7	=	19.98	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.63	x	0.7	=	13.87	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.63	x	0.7	=	7.72	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.63	x	0.7	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.63	x	0.7	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.63	x	0.7	=	65.11	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.63	x	0.7	=	110.9	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.63	x	0.7	=	151.74	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.63	x	0.7	=	188.01	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.63	x	0.7	=	210.59	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.63	x	0.7	=	209.07	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.63	x	0.7	=	201.56	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.63	x	0.7	=	184.72	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.63	x	0.7	=	164.3	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.63	x	0.7	=	122.57	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.63	x	0.7	=	77.98	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.63	x	0.7	=	55.72	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.63	x	0.7	=	23.62	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.63	x	0.7	=	7.55	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.63	x	0.7	=	48.08	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.63	x	0.7	=	15.37	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.63	x	0.7	=	86.62	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.63	x	0.7	=	27.69	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.63	x	0.7	=	142.26	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.63	x	0.7	=	45.48	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.63	x	0.7	=	191.23	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.63	x	0.7	=	61.14	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.63	x	0.7	=	203.87	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.63	x	0.7	=	65.18	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.63	x	0.7	=	190.72	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.63	x	0.7	=	60.97	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.63	x	0.7	=	152.04	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.63	x	0.7	=	48.61	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.63	x	0.7	=	105.55	(81)

Northwest	0.9x	0.77	x	2.19	x	50.42	x	0.63	x	0.7	=	33.75	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.63	x	0.7	=	58.76	(81)
Northwest	0.9x	0.77	x	2.19	x	28.07	x	0.63	x	0.7	=	18.79	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.63	x	0.7	=	29.72	(81)
Northwest	0.9x	0.77	x	2.19	x	14.2	x	0.63	x	0.7	=	9.5	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.63	x	0.7	=	19.29	(81)
Northwest	0.9x	0.77	x	2.19	x	9.21	x	0.63	x	0.7	=	6.17	(81)

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

(83)m=	99.38	180.67	277.44	394.45	488.08	504.9	478.31	405.34	317.47	207.83	121.11	83.71	(83)

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

(84)m=	457.82	536.55	620.32	716.73	789.53	786.17	746.8	680.08	603.02	514.17	451.27	431.81	(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	0.82	0.63	0.47	0.54	0.81	0.97	0.99	1	(86)

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

(87)m=	19.75	19.92	20.21	20.57	20.84	20.97	20.99	20.99	20.9	20.53	20.07	19.73	(87)

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

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	1	0.99	0.98	0.92	0.77	0.54	0.37	0.42	0.73	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=	18.28	18.53	18.94	19.46	19.81	19.94	19.96	19.96	19.88	19.41	18.76	18.25	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.85	19.07	19.43	19.89	20.21	20.34	20.36	20.36	20.27	19.84	19.27	18.82	(92)

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

(93)m=	18.85	19.07	19.43	19.89	20.21	20.34	20.36	20.36	20.27	19.84	19.27	18.82	(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	0.47	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.52	530.62	602.6	655.18	615.69	452.86	304.09	317.63	453.53	488.16	446.63	430.15	(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=	1224.18	1188.86	1081.63	907.1	700.72	467.24	306.12	321.54	504.74	761.12	1007.21	1216.5	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	571.88	442.33	356.39	181.38	63.26	0	0	0	0	203.09	403.62	585.04	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2806.99	(98)
Space heating requirement in kWh/m²/year	39.51	(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		93.4	(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)	571.88	442.33	356.39	181.38	63.26	0	0	0	0	203.09	403.62	585.04		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	612.29	473.59	381.58	194.19	67.73	0	0	0	0	217.44	432.14	626.38		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3005.34	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65		
Efficiency of water heater													80.3	(216)
(217)m=	87.62	87.37	86.8	85.44	83.04	80.3	80.3	80.3	80.3	85.6	87.1	87.71		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	220.49	193.16	202.28	182.27	181.56	165.37	158.43	176.62	178.57	190.74	200.12	215.08		
Total = Sum(219a)$_{1...12}$ =													2264.68	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3005.34	
Water heating fuel used			2264.68	
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			314.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5659.5	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	649.15	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1138.32	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		1340.47	(272)

TER = 18.87 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-202-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.18	=	8.44			(29)
Walls Type2	22.49	1.99	20.5	x	0.18	=	3.69			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 25.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (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 5.39 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.35 (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

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(38)m=	26.63	26.47	26.31	25.56	25.43	24.78	24.78	24.66	25.03	25.43	25.71	26	(38)

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

(39)m=	57.98	57.81	57.66	56.91	56.77	56.13	56.13	56.01	56.38	56.77	57.06	57.35	

Average = $Sum(39)_{1...12}$ /12= 56.91 (39)

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

(40)m=	1.15	1.15	1.14	1.13	1.13	1.11	1.11	1.11	1.12	1.13	1.13	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.95	279.74	269.52	253.5	237.54	221.91	211.96	217.29	225.65	241.84	260.34	274.06	(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	4.65	x	11.28	x	0.63	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.63	x	0.7	=	5.31	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.63	x	0.7	=	32.64	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.63	x	0.7	=	10.81	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.63	x	0.7	=	58.8	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.63	x	0.7	=	19.47	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.63	x	0.7	=	96.57	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.63	x	0.7	=	31.98	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.63	x	0.7	=	129.81	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.63	x	0.7	=	42.99	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.63	x	0.7	=	138.39	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.63	x	0.7	=	45.83	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.63	x	0.7	=	129.46	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.63	x	0.7	=	42.88	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.63	x	0.7	=	103.21	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.63	x	0.7	=	34.18	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.63	x	0.7	=	71.65	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.63	x	0.7	=	23.73	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.63	x	0.7	=	39.89	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.63	x	0.7	=	13.21	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.63	x	0.7	=	20.18	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.63	x	0.7	=	6.68	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.63	x	0.7	=	13.09	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.63	x	0.7	=	4.34	(75)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.63	x	0.7	=	30.81	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.63	x	0.7	=	52.48	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.63	x	0.7	=	71.81	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.63	x	0.7	=	88.97	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.63	x	0.7	=	99.66	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.63	x	0.7	=	98.94	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.63	x	0.7	=	95.39	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.63	x	0.7	=	87.41	(79)
Southwest 0.9x	0.77	x	1.37	x	92.85		0.63	x	0.7	=	77.75	(79)
Southwest 0.9x	0.77	x	1.37	x	69.27		0.63	x	0.7	=	58	(79)
Southwest 0.9x	0.77	x	1.37	x	44.07		0.63	x	0.7	=	36.9	(79)
Southwest 0.9x	0.77	x	1.37	x	31.49		0.63	x	0.7	=	26.37	(79)

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

(83)m=	52.15	95.93	150.09	217.53	272.46	283.16	267.73	224.81	173.14	111.1	63.76	43.8	(83)

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

(84)m=	334.1	375.67	419.61	471.03	510	505.07	479.68	442.1	398.79	352.94	324.1	317.86	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	0.99	0.98	0.95	0.85	0.67	0.51	0.57	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=	19.82	19.96	20.21	20.55	20.82	20.96	20.99	20.99	20.89	20.54	20.12	19.79	(87)

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

(88)m=	19.96	19.96	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.39	0.45	0.75	0.96	0.99	1	(89)

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

(90)m=	18.39	18.6	18.97	19.45	19.81	19.97	19.99	19.99	19.9	19.44	18.84	18.36	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.17	19.34	19.64	20.05	20.36	20.51	20.53	20.53	20.44	20.04	19.54	19.14	(92)

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

(93)m=	19.17	19.34	19.64	20.05	20.36	20.51	20.53	20.53	20.44	20.04	19.54	19.14	(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	0.98	0.93	0.82	0.63	0.46	0.51	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.36	371.95	409.87	439.36	418.62	317.55	218.63	227.42	314.23	337.49	320.82	316.55	(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=	861.95	834.97	757.85	634.53	491.77	331.58	220.83	231.38	357.28	535.85	709.68	856.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	394.02	311.15	258.9	140.52	54.43	0	0	0	0	147.58	279.98	402.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1988.61 (98)

Space heating requirement in kWh/m²/year 39.43 (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		93.4	(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)													
	394.02	311.15	258.9	140.52	54.43	0	0	0	0	147.58	279.98	402.03	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	421.86	333.14	277.19	150.45	58.27	0	0	0	0	158.01	299.77	430.44	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2129.13 (211)

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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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 80.3 (216)

(217)m=	87.18	86.96	86.43	85.21	83.07	80.3	80.3	80.3	80.3	85.22	86.64	87.28

(217)

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

(219)m=	187.67	164.36	172.04	154.78	153.71	140.06	134.18	149.58	151.24	162.28	170.38	183.06

Total = Sum(219a)$_{1...12}$ = 1923.33 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2129.13	
Water heating fuel used			1923.33	
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			239.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4366.71	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	459.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	415.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =			875.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1038.42	(272)

TER = 20.59 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Chris Hocknell
Stroma Number: STRO016363
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Flat-301-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.81	(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) =	0.16	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			1.99	x 1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]	=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]	=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]	=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]	=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x 0.18	=	10.72			(29)
Walls Type2	27.91	1.99	25.92	x 0.18	=	4.67			(29)
Total area of elements, m²			103.17						(31)
Party wall			10.99	x 0	=	0			(32)
Party floor			71.04						(32a)
Party ceiling			71.04						(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) = 38.23 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 8.1 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.33 (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=	37.79	37.55	37.32	36.22	36.01	35.06	35.06	34.88	35.42	36.01	36.43	36.86	(38)

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

(39)m=	84.12	83.88	83.64	82.55	82.34	81.39	81.39	81.21	81.75	82.34	82.76	83.19	

Average = Sum(39)$_{1…12}$ /12= 82.55 (39)

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

(40)m=	1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.16	1.17	

Average = Sum(40)$_{1…12}$ /12= 1.16 (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 2.27 (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 88.14 (43)

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

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

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

(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95

Total = Sum(44)$_{1…12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24

Total = Sum(45)$_{1…12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(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=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1...12}$ — 1915.45 (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)

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

(67)m=	17.81	15.82	12.86	9.74	7.28	6.15	6.64	8.63	11.58	14.71	17.17	18.3	(67)

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

(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)

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

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)

Water heating gains (Table 5)

(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)

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

(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.16	348.1	(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)

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Northeast	0.9x	0.77	x	0.9	x	11.28	x	0.63	x	0.7	=	3.1	(75)
Northeast	0.9x	0.77	x	0.9	x	22.97	x	0.63	x	0.7	=	6.32	(75)
Northeast	0.9x	0.77	x	0.9	x	41.38	x	0.63	x	0.7	=	11.38	(75)
Northeast	0.9x	0.77	x	0.9	x	67.96	x	0.63	x	0.7	=	18.69	(75)
Northeast	0.9x	0.77	x	0.9	x	91.35	x	0.63	x	0.7	=	25.12	(75)
Northeast	0.9x	0.77	x	0.9	x	97.38	x	0.63	x	0.7	=	26.79	(75)
Northeast	0.9x	0.77	x	0.9	x	91.1	x	0.63	x	0.7	=	25.06	(75)
Northeast	0.9x	0.77	x	0.9	x	72.63	x	0.63	x	0.7	=	19.98	(75)
Northeast	0.9x	0.77	x	0.9	x	50.42	x	0.63	x	0.7	=	13.87	(75)
Northeast	0.9x	0.77	x	0.9	x	28.07	x	0.63	x	0.7	=	7.72	(75)
Northeast	0.9x	0.77	x	0.9	x	14.2	x	0.63	x	0.7	=	3.9	(75)
Northeast	0.9x	0.77	x	0.9	x	9.21	x	0.63	x	0.7	=	2.53	(75)
Southeast	0.9x	0.77	x	5.79	x	36.79	x	0.63	x	0.7	=	65.11	(77)
Southeast	0.9x	0.77	x	5.79	x	62.67	x	0.63	x	0.7	=	110.9	(77)
Southeast	0.9x	0.77	x	5.79	x	85.75	x	0.63	x	0.7	=	151.74	(77)
Southeast	0.9x	0.77	x	5.79	x	106.25	x	0.63	x	0.7	=	188.01	(77)
Southeast	0.9x	0.77	x	5.79	x	119.01	x	0.63	x	0.7	=	210.59	(77)
Southeast	0.9x	0.77	x	5.79	x	118.15	x	0.63	x	0.7	=	209.07	(77)
Southeast	0.9x	0.77	x	5.79	x	113.91	x	0.63	x	0.7	=	201.56	(77)
Southeast	0.9x	0.77	x	5.79	x	104.39	x	0.63	x	0.7	=	184.72	(77)
Southeast	0.9x	0.77	x	5.79	x	92.85	x	0.63	x	0.7	=	164.3	(77)
Southeast	0.9x	0.77	x	5.79	x	69.27	x	0.63	x	0.7	=	122.57	(77)
Southeast	0.9x	0.77	x	5.79	x	44.07	x	0.63	x	0.7	=	77.98	(77)
Southeast	0.9x	0.77	x	5.79	x	31.49	x	0.63	x	0.7	=	55.72	(77)
Northwest	0.9x	0.77	x	1.37	x	11.28	x	0.63	x	0.7	=	23.62	(81)
Northwest	0.9x	0.77	x	2.19	x	11.28	x	0.63	x	0.7	=	7.55	(81)
Northwest	0.9x	0.77	x	1.37	x	22.97	x	0.63	x	0.7	=	48.08	(81)
Northwest	0.9x	0.77	x	2.19	x	22.97	x	0.63	x	0.7	=	15.37	(81)
Northwest	0.9x	0.77	x	1.37	x	41.38	x	0.63	x	0.7	=	86.62	(81)
Northwest	0.9x	0.77	x	2.19	x	41.38	x	0.63	x	0.7	=	27.69	(81)
Northwest	0.9x	0.77	x	1.37	x	67.96	x	0.63	x	0.7	=	142.26	(81)
Northwest	0.9x	0.77	x	2.19	x	67.96	x	0.63	x	0.7	=	45.48	(81)
Northwest	0.9x	0.77	x	1.37	x	91.35	x	0.63	x	0.7	=	191.23	(81)
Northwest	0.9x	0.77	x	2.19	x	91.35	x	0.63	x	0.7	=	61.14	(81)
Northwest	0.9x	0.77	x	1.37	x	97.38	x	0.63	x	0.7	=	203.87	(81)
Northwest	0.9x	0.77	x	2.19	x	97.38	x	0.63	x	0.7	=	65.18	(81)
Northwest	0.9x	0.77	x	1.37	x	91.1	x	0.63	x	0.7	=	190.72	(81)
Northwest	0.9x	0.77	x	2.19	x	91.1	x	0.63	x	0.7	=	60.97	(81)
Northwest	0.9x	0.77	x	1.37	x	72.63	x	0.63	x	0.7	=	152.04	(81)
Northwest	0.9x	0.77	x	2.19	x	72.63	x	0.63	x	0.7	=	48.61	(81)
Northwest	0.9x	0.77	x	1.37	x	50.42	x	0.63	x	0.7	=	105.55	(81)

Northwest 0.9x	0.77	x	2.19	x	50.42	x	0.63	x	0.7	=	33.75	(81)
Northwest 0.9x	0.77	x	1.37	x	28.07	x	0.63	x	0.7	=	58.76	(81)
Northwest 0.9x	0.77	x	2.19	x	28.07	x	0.63	x	0.7	=	18.79	(81)
Northwest 0.9x	0.77	x	1.37	x	14.2	x	0.63	x	0.7	=	29.72	(81)
Northwest 0.9x	0.77	x	2.19	x	14.2	x	0.63	x	0.7	=	9.5	(81)
Northwest 0.9x	0.77	x	1.37	x	9.21	x	0.63	x	0.7	=	19.29	(81)
Northwest 0.9x	0.77	x	2.19	x	9.21	x	0.63	x	0.7	=	6.17	(81)

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

(83)m=	99.38	180.67	277.44	394.45	488.08	504.9	478.31	405.34	317.47	207.83	121.11	83.71	(83)

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

(84)m=	457.82	536.55	620.32	716.73	789.53	786.17	746.8	680.08	603.02	514.17	451.27	431.81	(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	0.82	0.63	0.47	0.54	0.8	0.97	0.99	1	(86)

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

(87)m=	19.75	19.93	20.21	20.57	20.84	20.97	20.99	20.99	20.9	20.53	20.07	19.73	(87)

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

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	1	0.99	0.98	0.92	0.77	0.54	0.37	0.42	0.73	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=	18.28	18.53	18.94	19.46	19.81	19.94	19.96	19.96	19.88	19.41	18.76	18.25	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.85	19.07	19.43	19.89	20.21	20.34	20.36	20.36	20.27	19.84	19.27	18.82	(92)

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

(93)m=	18.85	19.07	19.43	19.89	20.21	20.34	20.36	20.36	20.27	19.84	19.27	18.82	(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	0.47	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.52	530.62	602.6	655.16	615.61	452.75	304.01	317.55	453.46	488.15	446.63	430.15	(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=	1223.85	1188.54	1081.34	906.85	700.53	467.11	306.04	321.45	504.6	760.92	1006.94	1216.17	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	571.64	442.12	356.18	181.22	63.17	0	0	0	0	202.94	403.42	584.8	(98)

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Total per year (kWh/year) = Sum(98)1...5,9...12 =	2805.5 (98)
Space heating requirement in kWh/m²/year	39.49 (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		93.4 (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)	571.64	442.12	356.18	181.22	63.17	0	0	0	0	202.94	403.42	584.8	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	612.03	473.36	381.35	194.03	67.64	0	0	0	0	217.28	431.93	626.12	(211)
Total (kWh/year) =Sum(211)1...5,10....12=													3003.75 (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)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	
Efficiency of water heater													80.3 (216)
(217)m=	87.62	87.36	86.8	85.43	83.04	80.3	80.3	80.3	80.3	85.6	87.1	87.71	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	220.49	193.16	202.29	182.28	181.56	165.37	158.43	176.62	178.57	190.75	200.12	215.08	
Total = Sum(219a)1...12 =													2264.71 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3003.75	
Water heating fuel used			2264.71	
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			314.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5657.94	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	648.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	489.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1137.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		1340.13	(272)

TER =	18.86	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-302-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.18	=	8.44			(29)
Walls Type2	22.49	1.99	20.5	x	0.18	=	3.69			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 25.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (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 5.39 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.35 (37)

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

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

(38)m=	26.63	26.47	26.31	25.56	25.43	24.78	24.78	24.66	25.03	25.43	25.71	26	(38)

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

(39)m=	57.98	57.81	57.66	56.91	56.77	56.13	56.13	56.01	56.38	56.77	57.06	57.35	

Average = $Sum(39)_{1...12}$ /12= 56.91 (39)

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

(40)m=	1.15	1.15	1.14	1.13	1.13	1.11	1.11	1.11	1.12	1.13	1.13	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)1…12	1622.26	(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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.95	279.74	269.52	253.5	237.54	221.91	211.96	217.29	225.65	241.84	260.34	274.06	(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	4.65	x	11.28	x	0.63	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.63	x	0.7	=	5.31	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.63	x	0.7	=	32.64	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.63	x	0.7	=	10.81	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.63	x	0.7	=	58.8	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.63	x	0.7	=	19.47	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.63	x	0.7	=	96.57	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.63	x	0.7	=	31.98	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.63	x	0.7	=	129.81	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.63	x	0.7	=	42.99	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.63	x	0.7	=	138.39	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.63	x	0.7	=	45.83	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.63	x	0.7	=	129.46	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.63	x	0.7	=	42.88	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.63	x	0.7	=	103.21	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.63	x	0.7	=	34.18	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.63	x	0.7	=	71.65	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.63	x	0.7	=	23.73	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.63	x	0.7	=	39.89	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.63	x	0.7	=	13.21	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.63	x	0.7	=	20.18	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.63	x	0.7	=	6.68	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.63	x	0.7	=	13.09	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.63	x	0.7	=	4.34	(75)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.63	x	0.7	=	30.81	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.63	x	0.7	=	52.48	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.63	x	0.7	=	71.81	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.63	x	0.7	=	88.97	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.63	x	0.7	=	99.66	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.63	x	0.7	=	98.94	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.63	x	0.7	=	95.39	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.63	x	0.7	=	87.41	(79)
Southwest 0.9x	0.77	x	1.37	x	92.85		0.63	x	0.7	=	77.75	(79)
Southwest 0.9x	0.77	x	1.37	x	69.27		0.63	x	0.7	=	58	(79)
Southwest 0.9x	0.77	x	1.37	x	44.07		0.63	x	0.7	=	36.9	(79)
Southwest 0.9x	0.77	x	1.37	x	31.49		0.63	x	0.7	=	26.37	(79)

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

(83)m=	52.15	95.93	150.09	217.53	272.46	283.16	267.73	224.81	173.14	111.1	63.76	43.8	(83)

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

(84)m=	334.1	375.67	419.61	471.03	510	505.07	479.68	442.1	398.79	352.94	324.1	317.86	(84)

7. Mean internal temperature (heating season)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.85	0.67	0.51	0.57	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=	19.82	19.96	20.21	20.55	20.82	20.96	20.99	20.99	20.89	20.54	20.12	19.79	(87)

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

(88)m=	19.96	19.96	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.39	0.45	0.75	0.96	0.99	1	(89)

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

(90)m=	18.39	18.6	18.97	19.45	19.81	19.97	19.99	19.99	19.9	19.44	18.84	18.36	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.17	19.34	19.64	20.05	20.36	20.51	20.53	20.53	20.44	20.04	19.54	19.14	(92)

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

(93)m=	19.17	19.34	19.64	20.05	20.36	20.51	20.53	20.53	20.44	20.04	19.54	19.14	(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	0.98	0.93	0.82	0.63	0.46	0.51	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.36	371.95	409.87	439.36	418.62	317.55	218.63	227.42	314.23	337.49	320.82	316.55	(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=	861.95	834.97	757.85	634.53	491.77	331.58	220.83	231.38	357.28	535.85	709.68	856.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	394.02	311.15	258.9	140.52	54.43	0	0	0	0	147.58	279.98	402.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1988.61 (98)

Space heating requirement in kWh/m²/year 39.43 (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		93.4	(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)													
	394.02	311.15	258.9	140.52	54.43	0	0	0	0	147.58	279.98	402.03	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	421.86	333.14	277.19	150.45	58.27	0	0	0	0	158.01	299.77	430.44	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2129.13 (211)

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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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 80.3 (216)

(217)m=	87.18	86.96	86.43	85.21	83.07	80.3	80.3	80.3	80.3	85.22	86.64	87.28	(217)

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

(219)m=	187.67	164.36	172.04	154.78	153.71	140.06	134.18	149.58	151.24	162.28	170.38	183.06

Total = Sum(219a)$_{1...12}$ = 1923.33 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2129.13	
Water heating fuel used		1923.33	
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		239.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4366.71	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	459.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	415.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =			875.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1038.42	(272)

TER = 20.59 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-401-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.81	(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) =	0.16	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.18	=	10.72			(29)
Walls Type2	27.91	1.99	25.92	x	0.18	=	4.67			(29)
Roof	75.26	0	75.26	x	0.13	=	9.78			(30)
Total area of elements, m²			178.43							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(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) =	48.01	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	21732.64	(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 27.58 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 75.59 (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=	37.79	37.55	37.32	36.22	36.01	35.06	35.06	34.88	35.42	36.01	36.43	36.86	(38)

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

(39)m=	113.37	113.14	112.9	111.8	111.6	110.64	110.64	110.47	111.01	111.6	112.01	112.45	

Average = $Sum(39)_{1…12}$ /12= 111.8 (39)

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

(40)m=	1.6	1.59	1.59	1.57	1.57	1.56	1.56	1.55	1.56	1.57	1.58	1.58	

Average = $Sum(40)_{1…12}$ /12= 1.57 (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 2.27 (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 88.14 (43)

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

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

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

(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95	

Total = $Sum(44)_{1…12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24	

Total = $Sum(45)_{1…12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1...12}$ — 1915.45 (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.81	15.82	12.86	9.74	7.28	6.15	6.64	8.63	11.58	14.71	17.17	18.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)
Water heating gains (Table 5)													
(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.16	348.1	(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)

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Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.63	x	0.7	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.63	x	0.7	=	11.38	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.63	x	0.7	=	18.69	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.63	x	0.7	=	25.12	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.63	x	0.7	=	26.79	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.63	x	0.7	=	25.06	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.63	x	0.7	=	19.98	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.63	x	0.7	=	13.87	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.63	x	0.7	=	7.72	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.63	x	0.7	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.63	x	0.7	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.63	x	0.7	=	65.11	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.63	x	0.7	=	110.9	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.63	x	0.7	=	151.74	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.63	x	0.7	=	188.01	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.63	x	0.7	=	210.59	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.63	x	0.7	=	209.07	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.63	x	0.7	=	201.56	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.63	x	0.7	=	184.72	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.63	x	0.7	=	164.3	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.63	x	0.7	=	122.57	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.63	x	0.7	=	77.98	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.63	x	0.7	=	55.72	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.63	x	0.7	=	23.62	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.63	x	0.7	=	7.55	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.63	x	0.7	=	48.08	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.63	x	0.7	=	15.37	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.63	x	0.7	=	86.62	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.63	x	0.7	=	27.69	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.63	x	0.7	=	142.26	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.63	x	0.7	=	45.48	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.63	x	0.7	=	191.23	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.63	x	0.7	=	61.14	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.63	x	0.7	=	203.87	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.63	x	0.7	=	65.18	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.63	x	0.7	=	190.72	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.63	x	0.7	=	60.97	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.63	x	0.7	=	152.04	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.63	x	0.7	=	48.61	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.63	x	0.7	=	105.55	(81)

Northwest	0.9x	0.77	x	2.19	x	50.42	x	0.63	x	0.7	=	33.75	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.63	x	0.7	=	58.76	(81)
Northwest	0.9x	0.77	x	2.19	x	28.07	x	0.63	x	0.7	=	18.79	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.63	x	0.7	=	29.72	(81)
Northwest	0.9x	0.77	x	2.19	x	14.2	x	0.63	x	0.7	=	9.5	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.63	x	0.7	=	19.29	(81)
Northwest	0.9x	0.77	x	2.19	x	9.21	x	0.63	x	0.7	=	6.17	(81)

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

(83)m=	99.38	180.67	277.44	394.45	488.08	504.9	478.31	405.34	317.47	207.83	121.11	83.71	(83)

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

(84)m=	457.82	536.55	620.32	716.73	789.53	786.17	746.8	680.08	603.02	514.17	451.27	431.81	(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	0.99	0.96	0.89	0.76	0.6	0.67	0.88	0.98	0.99	1	(86)

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

(87)m=	19.24	19.42	19.74	20.18	20.59	20.86	20.96	20.94	20.71	20.19	19.64	19.21	(87)

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

(88)m=	19.62	19.62	19.62	19.63	19.63	19.64	19.64	19.65	19.64	19.63	19.63	19.63	(88)

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

(89)m=	1	0.99	0.98	0.94	0.84	0.65	0.44	0.51	0.81	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=	17.32	17.59	18.06	18.69	19.24	19.55	19.63	19.62	19.41	18.71	17.91	17.29	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.06	18.3	18.71	19.27	19.76	20.06	20.14	20.13	19.91	19.28	18.58	18.03	(92)

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

(93)m=	18.06	18.3	18.71	19.27	19.76	20.06	20.14	20.13	19.91	19.28	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	0.99	0.98	0.94	0.85	0.68	0.5	0.57	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.11	530.52	605.01	671.39	668.13	536.66	376.97	387.82	497.22	493.5	446.49	429.76	(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=	1560.56	1515.74	1378.31	1159.09	899.33	603.85	391.97	411.92	645.2	969.16	1285.96	1555.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	822.45	662.06	575.34	351.15	172.02	0	0	0	0	353.89	604.42	837.28	

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	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	4378.61	(98)
Space heating requirement in kWh/m²/year		61.64	(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		93.4	(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)	822.45	662.06	575.34	351.15	172.02	0	0	0	0	353.89	604.42	837.28		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	880.57	708.85	615.99	375.96	184.17	0	0	0	0	378.9	647.13	896.44		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													4688.02	(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)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65		
Efficiency of water heater													80.3	(216)
(217)m=	88.29	88.15	87.82	87.04	85.38	80.3	80.3	80.3	80.3	86.95	87.92	88.36		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	218.81	191.44	199.93	178.92	176.58	165.37	158.43	176.62	178.57	187.79	198.23	213.51		
Total = Sum(219a)$_{1...12}$ =													2244.2	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4688.02	
Water heating fuel used			2244.2	
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			314.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7321.7	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x	0.216	=	1012.61	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	484.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1497.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		1699.5	(272)

TER = 23.92 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-402-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(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		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

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

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.18	=	8.44			(29)
Walls Type2	22.49	1.99	20.5	x	0.18	=	3.69			(29)
Roof	50.44	0	50.44	x	0.13	=	6.56			(30)
Total area of elements, m²			128.73							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(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) = 32.51 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17007.06 (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 20.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 52.99 (37)

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

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

(38)m=	26.63	26.47	26.31	25.56	25.43	24.78	24.78	24.66	25.03	25.43	25.71	26	(38)

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

(39)m=	79.62	79.46	79.3	78.56	78.42	77.77	77.77	77.65	78.02	78.42	78.7	78.99	

Average = Sum(39)$_{1...12}$ /12= 78.56 (39)

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

(40)m=	1.58	1.58	1.57	1.56	1.55	1.54	1.54	1.54	1.55	1.55	1.56	1.57	

Average = Sum(40)$_{1...12}$ /12= 1.56 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = Sum(44)$_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = Sum(45)$_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

TER WorkSheet: New dwelling design stage

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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ 1622.26 (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.55	12.03	9.79	7.41	5.54	4.68	5.05	6.57	8.81	11.19	13.06	13.92	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.95	279.74	269.52	253.5	237.54	221.91	211.96	217.29	225.65	241.84	260.34	274.06	(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	4.65	x	11.28	x	0.63	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.63	x	0.7	=	5.31	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.63	x	0.7	=	32.64	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.63	x	0.7	=	10.81	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.63	x	0.7	=	58.8	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.63	x	0.7	=	19.47	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.63	x	0.7	=	96.57	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.63	x	0.7	=	31.98	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.63	x	0.7	=	129.81	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.63	x	0.7	=	42.99	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.63	x	0.7	=	138.39	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.63	x	0.7	=	45.83	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.63	x	0.7	=	129.46	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.63	x	0.7	=	42.88	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.63	x	0.7	=	103.21	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.63	x	0.7	=	34.18	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.63	x	0.7	=	71.65	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.63	x	0.7	=	23.73	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.63	x	0.7	=	39.89	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.63	x	0.7	=	13.21	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.63	x	0.7	=	20.18	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.63	x	0.7	=	6.68	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.63	x	0.7	=	13.09	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.63	x	0.7	=	4.34	(75)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.63	x	0.7	=	30.81	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.63	x	0.7	=	52.48	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.63	x	0.7	=	71.81	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.63	x	0.7	=	88.97	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.63	x	0.7	=	99.66	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.63	x	0.7	=	98.94	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.63	x	0.7	=	95.39	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.63	x	0.7	=	87.41	(79)
Southwest 0.9x	0.77	x	1.37	x	92.85		0.63	x	0.7	=	77.75	(79)
Southwest 0.9x	0.77	x	1.37	x	69.27		0.63	x	0.7	=	58	(79)
Southwest 0.9x	0.77	x	1.37	x	44.07		0.63	x	0.7	=	36.9	(79)
Southwest 0.9x	0.77	x	1.37	x	31.49		0.63	x	0.7	=	26.37	(79)

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

(83)m=	52.15	95.93	150.09	217.53	272.46	283.16	267.73	224.81	173.14	111.1	63.76	43.8	(83)

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

(84)m=	334.1	375.67	419.61	471.03	510	505.07	479.68	442.1	398.79	352.94	324.1	317.86	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	1	0.99	0.99	0.97	0.91	0.79	0.65	0.71	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=	19.28	19.43	19.73	20.14	20.54	20.83	20.95	20.92	20.69	20.19	19.66	19.25	(87)

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

(88)m=	19.63	19.63	19.63	19.64	19.65	19.66	19.66	19.66	19.65	19.65	19.64	19.64	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.69	0.48	0.54	0.83	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=	17.38	17.61	18.04	18.64	19.19	19.54	19.64	19.63	19.39	18.71	17.95	17.35	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	18.41	18.6	18.96	19.46	19.93	20.24	20.35	20.33	20.1	19.51	18.88	18.38	(92)

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

(93)m=	18.41	18.6	18.96	19.46	19.93	20.24	20.35	20.33	20.1	19.51	18.88	18.38	(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	0.98	0.95	0.88	0.74	0.57	0.63	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	332.11	371.93	411.25	448.16	449.18	373.97	274.58	279.89	342.21	341.01	320.82	316.3	(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=	1123.77	1088.87	988.01	829.45	645.1	438.93	291.58	305.3	467.95	698.98	927.35	1120.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	588.99	481.78	429.11	274.53	145.77	0	0	0	0	266.33	436.7	598.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3221.5 (98)

Space heating requirement in kWh/m²/year 63.87 (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		93.4	(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)													
	588.99	481.78	429.11	274.53	145.77	0	0	0	0	266.33	436.7	598.3	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	630.61	515.83	459.43	293.93	156.07	0	0	0	0	285.15	467.56	640.58	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3449.14 (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)

	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77		
Efficiency of water heater													80.3	(216)
(217)m=	87.99	87.87	87.57	86.85	85.39	80.3	80.3	80.3	80.3	86.67	87.62	88.07		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	185.94	162.65	169.82	151.85	149.55	140.06	134.18	149.58	151.24	159.55	168.48	181.42		
Total = Sum(219a)$_{1...12}$ =													1904.31	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3449.14	
Water heating fuel used		1904.31	
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		239.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5667.7	(338)

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	=	745.02	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	411.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1156.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		1319.44	(272)

TER = 26.16 (273)

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Be Lean – DER from the Be Lean scenario DER SAP worksheet

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House- H01-LEAN

Address : West End Lane, LONDON, NW6 4NX

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	57.4	(1a)	x	2.1	(2a)	=	120.54	(3a)
Ground floor	53.06	(1b)	x	2.85	(2b)	=	151.22	(3b)
First floor	53.06	(1c)	x	3.08	(2c)	=	163.42	(3c)
Second floor	43.77	(1d)	x	2.26	(2d)	=	98.92	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	207.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	534.11	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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)	0.75	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling created by change of use

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.93	0.91	0.89	0.81	0.8	0.72	0.72	0.7	0.75	0.8	0.83	0.86	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.93	0.91	0.89	0.81	0.8	0.72	0.72	0.7	0.75	0.8	0.83	0.86	(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 Type 1			3.67	x	1.6	=	5.872			(26)
Doors Type 2			2.85	x	1.6	=	4.56			(26)
Doors Type 3			2.35	x	1	=	2.35			(26)
Windows Type 1			2.22		x1/[1/(1.6)+ 0.04]	=	3.34			(27)
Windows Type 2			1.13		x1/[1/(1.6)+ 0.04]	=	1.7			(27)
Windows Type 3			0.61		x1/[1/(1.6)+ 0.04]	=	0.92			(27)
Windows Type 4			2.25		x1/[1/(1.6)+ 0.04]	=	3.38			(27)
Windows Type 5			1.77		x1/[1/(1.6)+ 0.04]	=	2.66			(27)
Windows Type 6			1.31		x1/[1/(1.6)+ 0.04]	=	1.97			(27)
Windows Type 7			0.68		x1/[1/(1.6)+ 0.04]	=	1.02			(27)
Windows Type 8			2.69		x1/[1/(1.6)+ 0.04]	=	4.05			(27)
Windows Type 9			1.03		x1/[1/(1.6)+ 0.04]	=	1.55			(27)
Windows Type 10			2.9		x1/[1/(1.6)+ 0.04]	=	4.36			(27)
Rooflights			1.112034		x1/[1/(1.6) + 0.04]	=	1.779254			(27b)

DER WorkSheet: New dwelling created by change of use

Floor Type 1			57.4	x	0.25	=	14.35			(28)
Floor Type 2			53.06	x	0.25	=	13.265			(28)
Walls Type1	81.43	0	81.43	x	0.55	=	44.79			(29)
Walls Type2	15.31	6.41	8.9	x	0.15	=	1.34			(29)
Walls Type3	24.3	0	24.3	x	0.15	=	3.65			(29)
Walls Type4	101.44	33.57	67.87	x	0.55	=	37.33			(29)
Roof Type1	62.74	3.34	59.4	x	0.18	=	10.69			(30)
Roof Type2	10.96	0	10.96	x	0.18	=	1.97			(30)
Total area of elements, m²			406.64							(31)
Party wall			58.5	x	0	=	0			(32)

** 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) =	191.96	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39052.95	(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		61	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	252.95	(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=	163.22	160.41	157.6	143.56	140.75	126.71	126.71	123.9	132.32	140.75	146.37	151.99	(38)

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

(39)m=	416.18	413.37	410.56	396.51	393.7	379.66	379.66	376.85	385.28	393.7	399.32	404.94	

Average = Sum(39)1…12 /12= 395.81 (39)

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

(40)m=	2.01	1.99	1.98	1.91	1.9	1.83	1.83	1.82	1.86	1.9	1.93	1.95	

Average = Sum(40)1…12 /12= 1.91 (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 3.01 (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) + 36 105.72 (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=	116.29	112.06	107.84	103.61	99.38	95.15	95.15	99.38	103.61	107.84	112.06	116.29

Total = Sum(44)1…12 = 1268.65 (44)

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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=	172.46	150.83	155.65	135.7	130.2	112.36	104.11	119.47	120.9	140.9	153.8	167.02	

Total = Sum(45)1...12 = 1663.4 (45)

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

(46)m=	25.87	22.63	23.35	20.35	19.53	16.85	15.62	17.92	18.14	21.13	23.07	25.05	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.96	49.32	50.64	46.92	48.49	50.64	49.32	50.96	49.32	50.96	(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=	223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98	(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=	223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98	

Output from water heater (annual)1...12 2257.9 (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=	70.08	61.66	64.49	57.45	55.95	49.09	46.74	52.39	52.53	59.59	63.47	68.27	(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=	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	(66)

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

(67)m=	33.69	29.92	24.34	18.42	13.77	11.63	12.56	16.33	21.92	27.83	32.48	34.63	(67)

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

(68)m=	377.92	381.84	371.96	350.92	324.37	299.41	282.73	278.81	288.69	309.73	336.29	361.25	(68)

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

(69)m=	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	(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=	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	(71)

Water heating gains (Table 5)

(72)m=	94.2	91.75	86.68	79.79	75.21	68.18	62.82	70.41	72.96	80.09	88.15	91.76	(72)

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

(73)m=	576.98	574.69	554.15	520.31	484.51	450.38	429.29	436.72	454.74	488.82	528.09	558.81	(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	0.68	x	11.28	x	0.55	x	0.8	=	7.02	(75)
Northeast 0.9x	0.77	x	0.68	x	22.97	x	0.55	x	0.8	=	14.29	(75)
Northeast 0.9x	0.77	x	0.68	x	41.38	x	0.55	x	0.8	=	25.74	(75)
Northeast 0.9x	0.77	x	0.68	x	67.96	x	0.55	x	0.8	=	42.27	(75)
Northeast 0.9x	0.77	x	0.68	x	91.35	x	0.55	x	0.8	=	56.82	(75)
Northeast 0.9x	0.77	x	0.68	x	97.38	x	0.55	x	0.8	=	60.58	(75)
Northeast 0.9x	0.77	x	0.68	x	91.1	x	0.55	x	0.8	=	56.67	(75)
Northeast 0.9x	0.77	x	0.68	x	72.63	x	0.55	x	0.8	=	45.18	(75)
Northeast 0.9x	0.77	x	0.68	x	50.42	x	0.55	x	0.8	=	31.36	(75)
Northeast 0.9x	0.77	x	0.68	x	28.07	x	0.55	x	0.8	=	17.46	(75)
Northeast 0.9x	0.77	x	0.68	x	14.2	x	0.55	x	0.8	=	8.83	(75)
Northeast 0.9x	0.77	x	0.68	x	9.21	x	0.55	x	0.8	=	5.73	(75)
Southeast 0.9x	0.77	x	2.69	x	36.79	x	0.55	x	0.8	=	60.36	(77)
Southeast 0.9x	0.77	x	1.03	x	36.79	x	0.55	x	0.8	=	11.56	(77)
Southeast 0.9x	0.77	x	2.69	x	62.67	x	0.55	x	0.8	=	102.81	(77)
Southeast 0.9x	0.77	x	1.03	x	62.67	x	0.55	x	0.8	=	19.68	(77)
Southeast 0.9x	0.77	x	2.69	x	85.75	x	0.55	x	0.8	=	140.67	(77)
Southeast 0.9x	0.77	x	1.03	x	85.75	x	0.55	x	0.8	=	26.93	(77)
Southeast 0.9x	0.77	x	2.69	x	106.25	x	0.55	x	0.8	=	174.3	(77)
Southeast 0.9x	0.77	x	1.03	x	106.25	x	0.55	x	0.8	=	33.37	(77)
Southeast 0.9x	0.77	x	2.69	x	119.01	x	0.55	x	0.8	=	195.23	(77)

DER WorkSheet: New dwelling created by change of use

Southeast 0.9x	0.77	x	1.03	x	119.01	x	0.55	x	0.8	=	37.38	(77)
Southeast 0.9x	0.77	x	2.69	x	118.15	x	0.55	x	0.8	=	193.82	(77)
Southeast 0.9x	0.77	x	1.03	x	118.15	x	0.55	x	0.8	=	37.11	(77)
Southeast 0.9x	0.77	x	2.69	x	113.91	x	0.55	x	0.8	=	186.86	(77)
Southeast 0.9x	0.77	x	1.03	x	113.91	x	0.55	x	0.8	=	35.78	(77)
Southeast 0.9x	0.77	x	2.69	x	104.39	x	0.55	x	0.8	=	171.25	(77)
Southeast 0.9x	0.77	x	1.03	x	104.39	x	0.55	x	0.8	=	32.79	(77)
Southeast 0.9x	0.77	x	2.69	x	92.85	x	0.55	x	0.8	=	152.32	(77)
Southeast 0.9x	0.77	x	1.03	x	92.85	x	0.55	x	0.8	=	29.16	(77)
Southeast 0.9x	0.77	x	2.69	x	69.27	x	0.55	x	0.8	=	113.63	(77)
Southeast 0.9x	0.77	x	1.03	x	69.27	x	0.55	x	0.8	=	21.75	(77)
Southeast 0.9x	0.77	x	2.69	x	44.07	x	0.55	x	0.8	=	72.3	(77)
Southeast 0.9x	0.77	x	1.03	x	44.07	x	0.55	x	0.8	=	13.84	(77)
Southeast 0.9x	0.77	x	2.69	x	31.49	x	0.55	x	0.8	=	51.65	(77)
Southeast 0.9x	0.77	x	1.03	x	31.49	x	0.55	x	0.8	=	9.89	(77)
Southwest 0.9x	0.77	x	2.22	x	36.79		0.55	x	0.8	=	49.81	(79)
Southwest 0.9x	0.77	x	1.13	x	36.79		0.55	x	0.8	=	25.36	(79)
Southwest 0.9x	0.77	x	0.61	x	36.79		0.55	x	0.8	=	6.84	(79)
Southwest 0.9x	0.77	x	2.22	x	62.67		0.55	x	0.8	=	84.85	(79)
Southwest 0.9x	0.77	x	1.13	x	62.67		0.55	x	0.8	=	43.19	(79)
Southwest 0.9x	0.77	x	0.61	x	62.67		0.55	x	0.8	=	11.66	(79)
Southwest 0.9x	0.77	x	2.22	x	85.75		0.55	x	0.8	=	116.1	(79)
Southwest 0.9x	0.77	x	1.13	x	85.75		0.55	x	0.8	=	59.09	(79)
Southwest 0.9x	0.77	x	0.61	x	85.75		0.55	x	0.8	=	15.95	(79)
Southwest 0.9x	0.77	x	2.22	x	106.25		0.55	x	0.8	=	143.85	(79)
Southwest 0.9x	0.77	x	1.13	x	106.25		0.55	x	0.8	=	73.22	(79)
Southwest 0.9x	0.77	x	0.61	x	106.25		0.55	x	0.8	=	19.76	(79)
Southwest 0.9x	0.77	x	2.22	x	119.01		0.55	x	0.8	=	161.12	(79)
Southwest 0.9x	0.77	x	1.13	x	119.01		0.55	x	0.8	=	82.01	(79)
Southwest 0.9x	0.77	x	0.61	x	119.01		0.55	x	0.8	=	22.14	(79)
Southwest 0.9x	0.77	x	2.22	x	118.15		0.55	x	0.8	=	159.96	(79)
Southwest 0.9x	0.77	x	1.13	x	118.15		0.55	x	0.8	=	81.42	(79)
Southwest 0.9x	0.77	x	0.61	x	118.15		0.55	x	0.8	=	21.98	(79)
Southwest 0.9x	0.77	x	2.22	x	113.91		0.55	x	0.8	=	154.22	(79)
Southwest 0.9x	0.77	x	1.13	x	113.91		0.55	x	0.8	=	78.5	(79)
Southwest 0.9x	0.77	x	0.61	x	113.91		0.55	x	0.8	=	21.19	(79)
Southwest 0.9x	0.77	x	2.22	x	104.39		0.55	x	0.8	=	141.33	(79)
Southwest 0.9x	0.77	x	1.13	x	104.39		0.55	x	0.8	=	71.94	(79)
Southwest 0.9x	0.77	x	0.61	x	104.39		0.55	x	0.8	=	19.42	(79)
Southwest 0.9x	0.77	x	2.22	x	92.85		0.55	x	0.8	=	125.71	(79)
Southwest 0.9x	0.77	x	1.13	x	92.85		0.55	x	0.8	=	63.99	(79)

DER WorkSheet: New dwelling created by change of use

Southwest	0.9x	0.77	x	0.61	x	92.85		0.55	x	0.8	=	17.27	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27		0.55	x	0.8	=	93.78	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.55	x	0.8	=	47.73	(79)
Southwest	0.9x	0.77	x	0.61	x	69.27		0.55	x	0.8	=	12.88	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07		0.55	x	0.8	=	59.66	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.55	x	0.8	=	30.37	(79)
Southwest	0.9x	0.77	x	0.61	x	44.07		0.55	x	0.8	=	8.2	(79)
Southwest	0.9x	0.77	x	2.22	x	31.49		0.55	x	0.8	=	42.63	(79)
Southwest	0.9x	0.77	x	1.13	x	31.49		0.55	x	0.8	=	21.7	(79)
Southwest	0.9x	0.77	x	0.61	x	31.49		0.55	x	0.8	=	5.86	(79)
Northwest	0.9x	0.77	x	2.25	x	11.28	x	0.55	x	0.8	=	23.22	(81)
Northwest	0.9x	0.77	x	1.77	x	11.28	x	0.55	x	0.8	=	6.09	(81)
Northwest	0.9x	0.77	x	1.31	x	11.28	x	0.55	x	0.8	=	13.52	(81)
Northwest	0.9x	0.77	x	2.9	x	11.28	x	0.55	x	0.8	=	9.98	(81)
Northwest	0.9x	0.77	x	2.25	x	22.97	x	0.55	x	0.8	=	47.27	(81)
Northwest	0.9x	0.77	x	1.77	x	22.97	x	0.55	x	0.8	=	12.4	(81)
Northwest	0.9x	0.77	x	1.31	x	22.97	x	0.55	x	0.8	=	27.52	(81)
Northwest	0.9x	0.77	x	2.9	x	22.97	x	0.55	x	0.8	=	20.31	(81)
Northwest	0.9x	0.77	x	2.25	x	41.38	x	0.55	x	0.8	=	85.17	(81)
Northwest	0.9x	0.77	x	1.77	x	41.38	x	0.55	x	0.8	=	22.33	(81)
Northwest	0.9x	0.77	x	1.31	x	41.38	x	0.55	x	0.8	=	49.59	(81)
Northwest	0.9x	0.77	x	2.9	x	41.38	x	0.55	x	0.8	=	36.59	(81)
Northwest	0.9x	0.77	x	2.25	x	67.96	x	0.55	x	0.8	=	139.87	(81)
Northwest	0.9x	0.77	x	1.77	x	67.96	x	0.55	x	0.8	=	36.68	(81)
Northwest	0.9x	0.77	x	1.31	x	67.96	x	0.55	x	0.8	=	81.43	(81)
Northwest	0.9x	0.77	x	2.9	x	67.96	x	0.55	x	0.8	=	60.09	(81)
Northwest	0.9x	0.77	x	2.25	x	91.35	x	0.55	x	0.8	=	188.01	(81)
Northwest	0.9x	0.77	x	1.77	x	91.35	x	0.55	x	0.8	=	49.3	(81)
Northwest	0.9x	0.77	x	1.31	x	91.35	x	0.55	x	0.8	=	109.46	(81)
Northwest	0.9x	0.77	x	2.9	x	91.35	x	0.55	x	0.8	=	80.77	(81)
Northwest	0.9x	0.77	x	2.25	x	97.38	x	0.55	x	0.8	=	200.44	(81)
Northwest	0.9x	0.77	x	1.77	x	97.38	x	0.55	x	0.8	=	52.56	(81)
Northwest	0.9x	0.77	x	1.31	x	97.38	x	0.55	x	0.8	=	116.7	(81)
Northwest	0.9x	0.77	x	2.9	x	97.38	x	0.55	x	0.8	=	86.11	(81)
Northwest	0.9x	0.77	x	2.25	x	91.1	x	0.55	x	0.8	=	187.51	(81)
Northwest	0.9x	0.77	x	1.77	x	91.1	x	0.55	x	0.8	=	49.17	(81)
Northwest	0.9x	0.77	x	1.31	x	91.1	x	0.55	x	0.8	=	109.17	(81)
Northwest	0.9x	0.77	x	2.9	x	91.1	x	0.55	x	0.8	=	80.56	(81)
Northwest	0.9x	0.77	x	2.25	x	72.63	x	0.55	x	0.8	=	149.48	(81)
Northwest	0.9x	0.77	x	1.77	x	72.63	x	0.55	x	0.8	=	39.2	(81)
Northwest	0.9x	0.77	x	1.31	x	72.63	x	0.55	x	0.8	=	87.03	(81)

Northwest	0.9x	0.77	x	2.9	x	72.63	x	0.55	x	0.8	=	64.22	(81)
Northwest	0.9x	0.77	x	2.25	x	50.42	x	0.55	x	0.8	=	103.78	(81)
Northwest	0.9x	0.77	x	1.77	x	50.42	x	0.55	x	0.8	=	27.21	(81)
Northwest	0.9x	0.77	x	1.31	x	50.42	x	0.55	x	0.8	=	60.42	(81)
Northwest	0.9x	0.77	x	2.9	x	50.42	x	0.55	x	0.8	=	44.59	(81)
Northwest	0.9x	0.77	x	2.25	x	28.07	x	0.55	x	0.8	=	57.77	(81)
Northwest	0.9x	0.77	x	1.77	x	28.07	x	0.55	x	0.8	=	15.15	(81)
Northwest	0.9x	0.77	x	1.31	x	28.07	x	0.55	x	0.8	=	33.63	(81)
Northwest	0.9x	0.77	x	2.9	x	28.07	x	0.55	x	0.8	=	24.82	(81)
Northwest	0.9x	0.77	x	2.25	x	14.2	x	0.55	x	0.8	=	29.22	(81)
Northwest	0.9x	0.77	x	1.77	x	14.2	x	0.55	x	0.8	=	7.66	(81)
Northwest	0.9x	0.77	x	1.31	x	14.2	x	0.55	x	0.8	=	17.01	(81)
Northwest	0.9x	0.77	x	2.9	x	14.2	x	0.55	x	0.8	=	12.55	(81)
Northwest	0.9x	0.77	x	2.25	x	9.21	x	0.55	x	0.8	=	18.96	(81)
Northwest	0.9x	0.77	x	1.77	x	9.21	x	0.55	x	0.8	=	4.97	(81)
Northwest	0.9x	0.77	x	1.31	x	9.21	x	0.55	x	0.8	=	11.04	(81)
Northwest	0.9x	0.77	x	2.9	x	9.21	x	0.55	x	0.8	=	8.15	(81)
Rooflights	0.9x	1	x	1.11	x	37.03	x	0.55	x	0.8	=	48.92	(82)
Rooflights	0.9x	1	x	1.11	x	70.28	x	0.55	x	0.8	=	92.85	(82)
Rooflights	0.9x	1	x	1.11	x	111.87	x	0.55	x	0.8	=	147.79	(82)
Rooflights	0.9x	1	x	1.11	x	159.33	x	0.55	x	0.8	=	210.48	(82)
Rooflights	0.9x	1	x	1.11	x	193.3	x	0.55	x	0.8	=	255.37	(82)
Rooflights	0.9x	1	x	1.11	x	197.35	x	0.55	x	0.8	=	260.71	(82)
Rooflights	0.9x	1	x	1.11	x	188.08	x	0.55	x	0.8	=	248.47	(82)
Rooflights	0.9x	1	x	1.11	x	162.62	x	0.55	x	0.8	=	214.83	(82)
Rooflights	0.9x	1	x	1.11	x	128.66	x	0.55	x	0.8	=	169.98	(82)
Rooflights	0.9x	1	x	1.11	x	82.24	x	0.55	x	0.8	=	108.65	(82)
Rooflights	0.9x	1	x	1.11	x	45.75	x	0.55	x	0.8	=	60.44	(82)
Rooflights	0.9x	1	x	1.11	x	30.74	x	0.55	x	0.8	=	40.61	(82)

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

(83)m=	262.68	476.83	725.95	1015.33	1237.62	1271.38	1208.08	1036.66	825.78	547.26	320.09	221.2	(83)

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

(84)m=	839.66	1051.52	1280.1	1535.63	1722.13	1721.76	1637.36	1473.38	1280.52	1036.09	848.18	780.01	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.89	0.79	0.84	0.96	0.99	1	1	(86)

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

(87)m=	18.61	18.8	19.16	19.69	20.2	20.64	20.85	20.8	20.43	19.78	19.13	18.62	(87)

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

(88)m=	19.33	19.34	19.35	19.39	19.4	19.45	19.45	19.46	19.43	19.4	19.38	19.36	(88)

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

(89)m=	1	1	0.99	0.98	0.93	0.8	0.6	0.68	0.92	0.99	1	1	(89)

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

(90)m=	16.22	16.51	17.04	17.84	18.57	19.18	19.39	19.37	18.91	17.98	17.02	16.26	(90)

fLA = Living area ÷ (4) = 0.17 (91)

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

(92)m=	16.63	16.9	17.4	18.16	18.85	19.43	19.64	19.61	19.17	18.29	17.39	16.67	(92)

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

(93)m=	16.48	16.75	17.25	18.01	18.7	19.28	19.49	19.46	19.02	18.14	17.24	16.52	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.79	0.61	0.68	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	837.82	1046.54	1265.44	1487.2	1575.55	1362.22	991.51	996.94	1153.11	1017.79	844.89	778.75	(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=	5068.65	4898.76	4414.61	3612.72	2755.27	1776.56	1096.73	1153.54	1896.54	2966.67	4047.2	4987.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3147.73	2588.69	2342.98	1530.37	877.71	0	0	0	0	1449.97	2305.66	3130.96	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 17374.08 (98)

Space heating requirement in kWh/m²/year 83.82 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	3147.73	2588.69	2342.98	1530.37	877.71	0	0	0	0	1449.97	2305.66	3130.96	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	3485.86	2866.77	2594.66	1694.76	972	0	0	0	0	1605.72	2553.34	3467.28	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 19240.4 (211)

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

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

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

DER WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

223.42	196.86	206.61	185.01	180.85	159.28	152.6	170.11	170.22	191.86	203.12	217.98

Efficiency of water heater 81 (216)

(217)m=	89.62	89.57	89.47	89.2	88.56	81	81	81	81	89.1	89.47	89.63	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	249.3	219.78	230.93	207.42	204.2	196.64	188.4	210.02	210.14	215.32	227.03	243.2

Total = Sum(219a)$_{1...12}$ = 2602.36 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			19240.4	
Water heating fuel used			2602.36	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		716.77		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		746.77	(231)
Electricity for lighting			595.01	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			23184.54	(338)

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	=	4155.93	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	562.11	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4718.04	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	387.57	(267)
Electricity for lighting	(232)	x	0.519	=	308.81	(268)
Total CO2, kg/year			sum of (265)…(271) =		5414.42	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		26.12	(273)
EI rating (section 14)					71	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-G01-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	81.64	(1a) x	2.7	(2a) =	220.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.64	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		220.43	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.34	x1/[1/(1.4)+ 0.04]		=	5.75			(27)
Windows Type 3			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 4			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Floor			81.64	x	0.13	=	10.6132			(28)
Walls Type1	79.62	16.14	63.48	x	0.15	=	9.52			(29)
Walls Type2	53.08	1.99	51.09	x	0.15	=	7.66			(29)
Roof Type1	4.85	0	4.85	x	0.13	=	0.63			(30)
Roof Type2	1.55	0	1.55	x	0.13	=	0.2			(30)
Total area of elements, m²			220.74							(31)
Party ceiling			75.24							(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) = 52.02 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 30206.1 (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 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 73.53 (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=	20.06	19.83	19.6	18.44	18.21	17.05	17.05	16.82	17.51	18.21	18.67	19.14	(38)

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

(39)m=	93.59	93.36	93.13	91.97	91.74	90.58	90.58	90.35	91.04	91.74	92.2	92.67	

Average = $Sum(39)_{1...12}$ /12= 91.91 (39)

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

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.11	1.12	1.12	1.13	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (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 93.41 (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	95.28	91.55	87.81	84.07	84.07	87.81	91.55	95.28	99.02	102.76	

Total = $Sum(44)_{1...12}$ = 1120.97 (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=	152.38	133.28	137.53	119.9	115.05	99.28	92	105.57	106.83	124.5	135.9	147.58	

Total = $Sum(45)_{1...12}$ = 1469.77 (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	15.83	16.02	18.67	20.38	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)

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=	50.96	45.58	48.56	45.15	44.75	41.46	42.84	44.75	45.15	48.56	48.83	50.96	(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=	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53	(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=	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53	

Output from water heater (annual)$_{1...12}$ 2027.3 (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=	63.41	55.71	57.87	51.15	49.44	43.37	41.3	46.29	46.81	53.53	57.39	61.81	(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=	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	(66)

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

(67)m=	19.86	17.64	14.35	10.86	8.12	6.85	7.41	9.63	12.92	16.41	19.15	20.41	(67)

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

(68)m=	222.83	225.15	219.32	206.91	191.26	176.54	166.71	164.39	170.22	182.63	198.28	213	(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=	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	(71)

Water heating gains (Table 5)

(72)m=	85.23	82.9	77.78	71.05	66.45	60.24	55.51	62.21	65.01	71.95	79.71	83.08	(72)

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

(73)m=	391.32	389.09	374.84	352.22	329.22	307.03	293.02	299.63	311.55	334.39	360.55	379.89	(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	0.77	x	1.65	x	11.28	x	0.55	x	0.8	=	11.35	(75)
Northeast 0.9x	0.77	x	1.65	x	22.97	x	0.55	x	0.8	=	23.11	(75)
Northeast 0.9x	0.77	x	1.65	x	41.38	x	0.55	x	0.8	=	41.64	(75)
Northeast 0.9x	0.77	x	1.65	x	67.96	x	0.55	x	0.8	=	68.38	(75)
Northeast 0.9x	0.77	x	1.65	x	91.35	x	0.55	x	0.8	=	91.92	(75)
Northeast 0.9x	0.77	x	1.65	x	97.38	x	0.55	x	0.8	=	97.99	(75)
Northeast 0.9x	0.77	x	1.65	x	91.1	x	0.55	x	0.8	=	91.67	(75)
Northeast 0.9x	0.77	x	1.65	x	72.63	x	0.55	x	0.8	=	73.08	(75)
Northeast 0.9x	0.77	x	1.65	x	50.42	x	0.55	x	0.8	=	50.74	(75)
Northeast 0.9x	0.77	x	1.65	x	28.07	x	0.55	x	0.8	=	28.24	(75)
Northeast 0.9x	0.77	x	1.65	x	14.2	x	0.55	x	0.8	=	14.29	(75)
Northeast 0.9x	0.77	x	1.65	x	9.21	x	0.55	x	0.8	=	9.27	(75)
Southeast 0.9x	0.77	x	5.76	x	36.79	x	0.55	x	0.8	=	64.62	(77)
Southeast 0.9x	0.77	x	5.76	x	62.67	x	0.55	x	0.8	=	110.08	(77)
Southeast 0.9x	0.77	x	5.76	x	85.75	x	0.55	x	0.8	=	150.61	(77)
Southeast 0.9x	0.77	x	5.76	x	106.25	x	0.55	x	0.8	=	186.61	(77)
Southeast 0.9x	0.77	x	5.76	x	119.01	x	0.55	x	0.8	=	209.02	(77)
Southeast 0.9x	0.77	x	5.76	x	118.15	x	0.55	x	0.8	=	207.51	(77)
Southeast 0.9x	0.77	x	5.76	x	113.91	x	0.55	x	0.8	=	200.06	(77)
Southeast 0.9x	0.77	x	5.76	x	104.39	x	0.55	x	0.8	=	183.35	(77)
Southeast 0.9x	0.77	x	5.76	x	92.85	x	0.55	x	0.8	=	163.08	(77)
Southeast 0.9x	0.77	x	5.76	x	69.27	x	0.55	x	0.8	=	121.66	(77)
Southeast 0.9x	0.77	x	5.76	x	44.07	x	0.55	x	0.8	=	77.4	(77)
Southeast 0.9x	0.77	x	5.76	x	31.49	x	0.55	x	0.8	=	55.3	(77)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest 0.9x	0.77	x	4.34	x	36.79		0.55	x	0.8	=	48.69	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest 0.9x	0.77	x	4.34	x	62.67		0.55	x	0.8	=	82.94	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest 0.9x	0.77	x	4.34	x	85.75		0.55	x	0.8	=	113.48	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest 0.9x	0.77	x	4.34	x	106.25		0.55	x	0.8	=	140.61	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest 0.9x	0.77	x	4.34	x	119.01		0.55	x	0.8	=	157.49	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest 0.9x	0.77	x	4.34	x	118.15		0.55	x	0.8	=	156.35	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest 0.9x	0.77	x	4.34	x	113.91		0.55	x	0.8	=	150.74	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	4.34	x	104.39	0.55	x	0.8	=	138.15	(79)
Southwest	0.9x	0.77	x	1.37	x	92.85	0.55	x	0.8	=	77.58	(79)
Southwest	0.9x	0.77	x	4.34	x	92.85	0.55	x	0.8	=	122.88	(79)
Southwest	0.9x	0.77	x	1.37	x	69.27	0.55	x	0.8	=	57.87	(79)
Southwest	0.9x	0.77	x	4.34	x	69.27	0.55	x	0.8	=	91.67	(79)
Southwest	0.9x	0.77	x	1.37	x	44.07	0.55	x	0.8	=	36.82	(79)
Southwest	0.9x	0.77	x	4.34	x	44.07	0.55	x	0.8	=	58.32	(79)
Southwest	0.9x	0.77	x	1.37	x	31.49	0.55	x	0.8	=	26.31	(79)
Southwest	0.9x	0.77	x	4.34	x	31.49	0.55	x	0.8	=	41.67	(79)

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

(83)m=	155.41	268.49	377.37	484.37	557.86	560.57	537.64	481.79	414.27	299.44	186.83	132.55	(83)

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

(84)m=	546.73	657.57	752.22	836.59	887.09	867.6	830.66	781.42	725.82	633.82	547.38	512.44	(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	0.93	0.82	0.64	0.47	0.52	0.77	0.95	0.99	1	(86)

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

(87)m=	19.83	20.02	20.29	20.61	20.85	20.97	20.99	20.99	20.92	20.6	20.15	19.79	(87)

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

(88)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	20	19.99	19.98	19.98	19.97	(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	0.55	0.37	0.41	0.69	0.93	0.99	1	(89)

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

(90)m=	18.41	18.69	19.08	19.54	19.85	19.97	19.99	19.99	19.93	19.53	18.88	18.37	(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	18.89	19.14	19.49	19.9	20.18	20.31	20.33	20.33	20.26	19.89	19.31	18.85	(92)

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

(93)m=	18.74	18.99	19.34	19.75	20.03	20.16	20.18	20.18	20.11	19.74	19.16	18.7	(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	0.98	0.96	0.9	0.77	0.57	0.39	0.43	0.7	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.3	647.48	723.72	753.29	681.99	490.39	322.61	338.68	509.22	588.73	539.79	510.06	(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=	1351.14	1315.13	1195.52	997.86	764.6	503.51	324.13	341.32	547.42	838.23	1111.9	1343.3	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	601.03	448.66	351.01	176.1	61.46	0	0	0	0	185.63	411.93	619.93

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2855.74 (98)

Space heating requirement in kWh/m²/year 34.98 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)	601.03	448.66	351.01	176.1	61.46	0	0	0	0	185.63	411.93	619.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	665.59	496.86	388.72	195.01	68.06	0	0	0	0	205.57	456.17	686.52		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3162.51	(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)	203.34	178.85	186.08	165.05	159.79	140.74	134.84	150.31	151.97	173.05	184.73	198.53		
Efficiency of water heater													81	(216)
(217)m=	87.75	87.44	86.85	85.55	83.39	81	81	81	81	85.56	87.2	87.85		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	231.72	204.55	214.27	192.93	191.63	173.75	166.47	185.57	187.62	202.26	211.84	225.98		
Total = Sum(219a)$_{1...12}$ =													2388.6	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3162.51	
Water heating fuel used			2388.6	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		295.81		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		325.81	(231)
Electricity for lighting			350.77	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6227.69	(338)

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

DER WorkSheet: New dwelling design stage

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	683.1	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	515.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1199.04	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	169.1	(267)
Electricity for lighting	(232)	x	0.519	=	182.05	(268)
Total CO2, kg/year			sum of (265)…(271) =		1550.19	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.99	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-101-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	79.31	(1a)	x	2.63	(2a)	=	208.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	208.59	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.35	(23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.81	x1/[1/(1.4)+ 0.04]		=	7.7			(27)
Windows Type 4			4.37	x1/[1/(1.4)+ 0.04]		=	5.79			(27)
Windows Type 5			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Rooflights			3.06414	x1/[1/(1.4) + 0.04]		=	4.289796			(27b)
Floor			55.4	x	0.13	=	7.202			(28)
Walls Type1	70.84	17.98	52.86	x	0.15	=	7.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Roof Type1	5.84	3.06	2.78	x	0.13	=	0.36			(30)
Roof Type2	0.17	0	0.17	x	0.13	=	0.02			(30)
Total area of elements, m²			160.16							(31)
Party wall			17.81	x	0	=	0			(32)
Party floor			23.91							(32a)
Party ceiling			70.27							(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) =	49.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	25420.01	(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 | 24.58 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = | 73.87 | (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=	18.99	18.77	18.55	17.45	17.23	16.13	16.13	15.91	16.57	17.23	17.67	18.11	(38)

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

(39)m=	92.86	92.64	92.42	91.32	91.1	90	90	89.78	90.44	91.1	91.54	91.98

Average = Sum(39)$_{1\ldots12}$ /12= | 91.27 | (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.13	1.13	1.13	1.14	1.15	1.15	1.16

Average = Sum(40)$_{1\ldots12}$ /12= | 1.15 | (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 | 2.45 | (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 | 92.38 | (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=	101.62	97.92	94.23	90.53	86.84	83.14	83.14	86.84	90.53	94.23	97.92	101.62

Total = Sum(44)$_{1\ldots12}$ = | 1108.55 | (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=	150.69	131.8	136	118.57	113.77	98.18	90.98	104.4	105.64	123.12	134.39	145.94

Total = Sum(45)$_{1\ldots12}$ = | 1453.48 | (45)

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

(46)m=	22.6	19.77	20.4	17.79	17.07	14.73	13.65	15.66	15.85	18.47	20.16	21.89	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

DER WorkSheet: New dwelling design stage

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	45.07	48.02	44.65	44.25	41	42.37	44.25	44.65	48.02	48.29	50.96	(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=	201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9	(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=	201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9	

Output from water heater (annual)$_{1...12}$ — 2005.95 — (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=	62.85	55.09	57.23	50.59	48.89	42.89	40.84	45.77	46.29	52.94	56.76	61.26	(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=	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	(66)

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

(67)m=	19.43	17.26	14.04	10.63	7.94	6.71	7.25	9.42	12.64	16.05	18.74	19.97	(67)

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

(68)m=	217.99	220.25	214.55	202.42	187.1	172.7	163.08	160.82	166.52	178.66	193.98	208.37	(68)

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

(69)m=	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	(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=	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	(71)

Water heating gains (Table 5)

(72)m=	84.47	81.98	76.92	70.26	65.72	59.58	54.89	61.52	64.29	71.16	78.83	82.35	(72)

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

(73)m=	384.64	382.24	368.25	346.05	323.5	301.73	287.97	294.51	306.2	328.61	354.29	373.44	(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	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.81	x	36.79	x	0.55	x	0.8	=	65.18	(77)
Southeast 0.9x	0.77	x	5.81	x	62.67	x	0.55	x	0.8	=	111.03	(77)
Southeast 0.9x	0.77	x	5.81	x	85.75	x	0.55	x	0.8	=	151.92	(77)
Southeast 0.9x	0.77	x	5.81	x	106.25	x	0.55	x	0.8	=	188.23	(77)
Southeast 0.9x	0.77	x	5.81	x	119.01	x	0.55	x	0.8	=	210.84	(77)
Southeast 0.9x	0.77	x	5.81	x	118.15	x	0.55	x	0.8	=	209.31	(77)
Southeast 0.9x	0.77	x	5.81	x	113.91	x	0.55	x	0.8	=	201.8	(77)
Southeast 0.9x	0.77	x	5.81	x	104.39	x	0.55	x	0.8	=	184.94	(77)
Southeast 0.9x	0.77	x	5.81	x	92.85	x	0.55	x	0.8	=	164.5	(77)
Southeast 0.9x	0.77	x	5.81	x	69.27	x	0.55	x	0.8	=	122.71	(77)
Southeast 0.9x	0.77	x	5.81	x	44.07	x	0.55	x	0.8	=	78.07	(77)
Southeast 0.9x	0.77	x	5.81	x	31.49	x	0.55	x	0.8	=	55.78	(77)
Southwest 0.9x	0.77	x	4.16	x	36.79		0.55	x	0.8	=	46.67	(79)
Southwest 0.9x	0.77	x	4.16	x	62.67		0.55	x	0.8	=	79.5	(79)
Southwest 0.9x	0.77	x	4.16	x	85.75		0.55	x	0.8	=	108.77	(79)
Southwest 0.9x	0.77	x	4.16	x	106.25		0.55	x	0.8	=	134.78	(79)
Southwest 0.9x	0.77	x	4.16	x	119.01		0.55	x	0.8	=	150.96	(79)
Southwest 0.9x	0.77	x	4.16	x	118.15		0.55	x	0.8	=	149.87	(79)
Southwest 0.9x	0.77	x	4.16	x	113.91		0.55	x	0.8	=	144.49	(79)
Southwest 0.9x	0.77	x	4.16	x	104.39		0.55	x	0.8	=	132.42	(79)
Southwest 0.9x	0.77	x	4.16	x	92.85		0.55	x	0.8	=	117.78	(79)
Southwest 0.9x	0.77	x	4.16	x	69.27		0.55	x	0.8	=	87.86	(79)
Southwest 0.9x	0.77	x	4.16	x	44.07		0.55	x	0.8	=	55.9	(79)
Southwest 0.9x	0.77	x	4.16	x	31.49		0.55	x	0.8	=	39.94	(79)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	9.43	(81)
Northwest 0.9x	0.77	x	4.37	x	11.28	x	0.55	x	0.8	=	15.03	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	19.19	(81)

Northwest 0.9x	0.77	x	4.37	x	22.97	x	0.55	x	0.8	=	30.6	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	34.57	(81)
Northwest 0.9x	0.77	x	4.37	x	41.38	x	0.55	x	0.8	=	55.14	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	56.78	(81)
Northwest 0.9x	0.77	x	4.37	x	67.96	x	0.55	x	0.8	=	90.55	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	76.32	(81)
Northwest 0.9x	0.77	x	4.37	x	91.35	x	0.55	x	0.8	=	121.72	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	81.36	(81)
Northwest 0.9x	0.77	x	4.37	x	97.38	x	0.55	x	0.8	=	129.76	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	76.11	(81)
Northwest 0.9x	0.77	x	4.37	x	91.1	x	0.55	x	0.8	=	121.39	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	60.68	(81)
Northwest 0.9x	0.77	x	4.37	x	72.63	x	0.55	x	0.8	=	96.78	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	42.13	(81)
Northwest 0.9x	0.77	x	4.37	x	50.42	x	0.55	x	0.8	=	67.19	(81)
Northwest 0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	23.45	(81)
Northwest 0.9x	0.77	x	4.37	x	28.07	x	0.55	x	0.8	=	37.4	(81)
Northwest 0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	11.86	(81)
Northwest 0.9x	0.77	x	4.37	x	14.2	x	0.55	x	0.8	=	18.92	(81)
Northwest 0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	7.7	(81)
Northwest 0.9x	0.77	x	4.37	x	9.21	x	0.55	x	0.8	=	12.28	(81)
Rooflights 0.9x	1	x	3.06	x	18.07	x	0.55	x	0.8	=	21.93	(82)
Rooflights 0.9x	1	x	3.06	x	37.96	x	0.55	x	0.8	=	46.06	(82)
Rooflights 0.9x	1	x	3.06	x	71.02	x	0.55	x	0.8	=	86.18	(82)
Rooflights 0.9x	1	x	3.06	x	119.98	x	0.55	x	0.8	=	145.58	(82)
Rooflights 0.9x	1	x	3.06	x	163.58	x	0.55	x	0.8	=	198.49	(82)
Rooflights 0.9x	1	x	3.06	x	175.24	x	0.55	x	0.8	=	212.64	(82)
Rooflights 0.9x	1	x	3.06	x	163.61	x	0.55	x	0.8	=	198.52	(82)
Rooflights 0.9x	1	x	3.06	x	129.11	x	0.55	x	0.8	=	156.67	(82)
Rooflights 0.9x	1	x	3.06	x	87.66	x	0.55	x	0.8	=	106.37	(82)
Rooflights 0.9x	1	x	3.06	x	47.1	x	0.55	x	0.8	=	57.15	(82)
Rooflights 0.9x	1	x	3.06	x	22.95	x	0.55	x	0.8	=	27.85	(82)
Rooflights 0.9x	1	x	3.06	x	14.62	x	0.55	x	0.8	=	17.74	(82)

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

(83)m=	161.34	292.69	447.93	634.57	783.39	809.67	767.32	651.4	511.8	336.28	196.5	135.97	(83)

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

(84)m=	545.98	674.93	816.19	980.62	1106.9	1111.4	1055.29	945.92	817.99	664.89	550.79	509.41	(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

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(86)m=	1	0.99	0.96	0.88	0.71	0.51	0.37	0.43	0.71	0.94	0.99	1	(86)

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

(87)m=	19.81	20.03	20.35	20.71	20.92	20.99	21	21	20.94	20.62	20.14	19.77	(87)

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

(88)m=	19.94	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.96	19.95	(88)

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

(89)m=	1	0.99	0.95	0.85	0.65	0.43	0.29	0.34	0.62	0.92	0.99	1	(89)

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

(90)m=	18.37	18.69	19.14	19.65	19.89	19.97	19.97	19.97	19.93	19.54	18.86	18.32	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	18.87	19.15	19.56	20.02	20.25	20.32	20.33	20.33	20.28	19.91	19.3	18.82	(92)

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

(93)m=	18.72	19	19.41	19.87	20.1	20.17	20.18	20.18	20.13	19.76	19.15	18.67	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.84	0.65	0.45	0.3	0.36	0.64	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	542.17	662.38	772.66	826.18	723.94	496.4	321.39	337.94	519.83	607.22	542.17	506.8	(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=	1339.04	1306.21	1193.2	1001.35	765.31	501.26	321.93	339.12	545.4	834.94	1103.35	1331.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	592.87	432.66	312.88	126.13	30.78	0	0	0	0	169.42	404.05	613.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2682.26 (98)

Space heating requirement in kWh/m²/year 33.82 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	592.87	432.66	312.88	126.13	30.78	0	0	0	0	169.42	404.05	613.48	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	656.56	479.13	346.49	139.67	34.08	0	0	0	0	187.62	447.45	679.38	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2970.39 (211)

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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)

201.65	176.87	184.02	163.22	158.02	139.18	133.34	148.65	150.29	171.13	182.68	196.9

Efficiency of water heater 81 (216)

(217)m=	87.74	87.39	86.62	84.81	82.38	81	81	81	81	85.37	87.18	87.85	(217)

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

(219)m=	229.82	202.39	212.45	192.46	191.82	171.82	164.62	183.51	185.54	200.45	209.54	224.13

Total = Sum(219a)$_{1...12}$ = 2368.56 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2970.39	
Water heating fuel used		2368.56	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	241.75		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		271.75	(231)
Electricity for lighting		343.21	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		5953.92	(338)

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	=	641.6	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	511.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1153.21	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	141.04	(267)
Electricity for lighting	(232)	x	0.519	=	178.13	(268)
Total CO2, kg/year			sum of (265)…(271) =		1472.38	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.56	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-102-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 11 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.94 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

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

(39)m=	47.33	47.19	47.05	46.33	46.19	45.47	45.47	45.33	45.76	46.19	46.47	46.76	

Average = $Sum(39)_{1...12}$ /12= 46.3 (39)

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

(40)m=	0.94	0.94	0.93	0.92	0.92	0.9	0.9	0.9	0.91	0.92	0.92	0.93	

Average = $Sum(40)_{1...12}$ /12= 0.92 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.71	279.53	269.35	253.37	237.44	221.83	211.87	217.17	225.49	241.64	260.1	273.81	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

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

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

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

(84)m=	333.75	375.24	419.09	470.41	509.28	504.35	478.99	441.47	398.24	352.49	323.72	317.51	(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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.98	0.92	0.78	0.57	0.42	0.47	0.74	0.95	0.99	1		(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)														
(87)m=	20.11	20.25	20.47	20.75	20.93	20.99	21	21	20.96	20.72	20.37	20.09		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)														
(88)m=	20.13	20.14	20.14	20.15	20.15	20.17	20.17	20.17	20.16	20.15	20.15	20.14		(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)														
(89)m=	1	0.99	0.97	0.9	0.72	0.5	0.34	0.39	0.67	0.94	0.99	1		(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)														
(90)m=	18.95	19.15	19.47	19.87	20.09	20.16	20.17	20.17	20.13	19.84	19.33	18.92		(90)
fLA = Living area ÷ (4) =													0.54	(91)
Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2														
(92)m=	19.58	19.75	20.02	20.35	20.55	20.61	20.62	20.62	20.58	20.32	19.9	19.56		(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate														
(93)m=	19.43	19.6	19.87	20.2	20.4	20.46	20.47	20.47	20.43	20.17	19.75	19.41		(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	0.9	0.74	0.52	0.37	0.42	0.7	0.94	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	331.82	370.72	405.88	423.15	376.98	264.05	175.69	183.96	277.15	329.72	319.66	316.11		(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=	716.33	693.64	628.88	523.56	401.84	266.6	175.93	184.46	289.82	441.87	587.79	711.18		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	286.08	217	165.91	72.3	18.5	0	0	0	0	83.44	193.05	293.93		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													1330.21	(98)
Space heating requirement in kWh/m²/year													26.37	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)														
	286.08	217	165.91	72.3	18.5	0	0	0	0	83.44	193.05	293.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	316.81	240.31	183.73	80.06	20.48	0	0	0	0	92.4	213.79	325.5		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1473.1	(211)

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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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 81 (216)

(217)m=	86.68	86.36	85.65	84.07	82.07	81	81	81	81	84.27	86.02	86.79	(217)

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

(219)m=	188.76	165.49	173.61	156.89	155.59	138.84	133.02	148.29	149.93	164.11	171.61	184.09

Total = Sum(219a)$_{1...12}$ = 1930.23 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1473.1	
Water heating fuel used			1930.23	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		157.84		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		187.84	(231)
Electricity for lighting			234.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3826.15	(338)

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	=	318.19	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	416.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			735.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.49	(267)
Electricity for lighting	(232) x	0.519	=	121.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		954.56	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.92	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-201-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.04	(1a)	x	2.7	(2a)	=	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Total area of elements, m²			103.17							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(32a)
Party ceiling			71.04							(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) = 35.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 12.76 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.42 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

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

(39)m=	65.88	65.68	65.47	64.47	64.26	63.26	63.26	63.05	63.66	64.26	64.67	65.07	

Average = Sum(39)$_{1…12}$ /12= 64.42 (39)

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

(40)m=	0.93	0.92	0.92	0.91	0.9	0.89	0.89	0.89	0.9	0.9	0.91	0.92	

Average = Sum(40)$_{1…12}$ /12= 0.91 (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 2.27 (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 88.14 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95	

Total = Sum(44)$_{1…12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24	

Total = Sum(45)$_{1…12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(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)

DER WorkSheet: New dwelling design stage

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

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

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

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

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

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

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

(61)m=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1...12}$ — 1915.45 (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)

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

(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)

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

(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)

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

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)

Water heating gains (Table 5)

(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)

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

(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.15	348.1	(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)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest 0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest 0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest 0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest 0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest 0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest 0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest 0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

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

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

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

(84)m=	457.6	536.14	619.69	715.84	788.43	785.03	745.71	679.16	602.29	513.7	450.99	431.61	(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	0.97	0.89	0.72	0.51	0.37	0.43	0.7	0.95	0.99	1	(86)

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

(87)m=	20.11	20.28	20.52	20.81	20.96	21	21	21	20.97	20.75	20.38	20.09	(87)

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

(88)m=	20.14	20.15	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

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

(89)m=	1	0.99	0.96	0.87	0.67	0.45	0.3	0.35	0.63	0.92	0.99	1	(89)

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

(90)m=	18.96	19.2	19.55	19.95	20.13	20.17	20.18	20.18	20.15	19.88	19.35	18.92	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.4	19.61	19.93	20.28	20.45	20.49	20.49	20.49	20.47	20.21	19.75	19.37	(92)

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

(93)m=	19.25	19.46	19.78	20.13	20.3	20.34	20.34	20.34	20.32	20.06	19.6	19.22	(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	0.96	0.86	0.67	0.46	0.32	0.37	0.64	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.11	528.73	594.13	618.4	532.08	361.48	236.68	248.43	385.17	473.1	445.17	429.9	(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=	985.12	956.41	869.18	723.79	552.47	363.12	236.81	248.73	395.91	608.25	808.21	977.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	394.33	287.4	204.63	75.88	15.17	0	0	0	0	100.56	261.39	407.46	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1746.81	(98)
Space heating requirement in kWh/m²/year	24.59	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)	394.33	287.4	204.63	75.88	15.17	0	0	0	0	100.56	261.39	407.46		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	436.69	318.27	226.61	84.03	16.8	0	0	0	0	111.36	289.47	451.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1934.45	(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)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65		
Efficiency of water heater													81	(216)
(217)m=	87.01	86.62	85.75	83.83	81.77	81	81	81	81	84.31	86.33	87.13		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	222.01	194.82	204.74	185.77	184.38	163.94	157.07	175.09	177.02	193.67	201.88	216.5		
Total = Sum(219a)$_{1...12}$ =													2276.89	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1934.45	
Water heating fuel used			2276.89	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		222.31		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		252.31	(231)
Electricity for lighting			314.43	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4778.08	(338)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	417.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	491.81	(264)
Space and water heating	(261) + (262) + (263) + (264) =			909.65	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	130.95	(267)
Electricity for lighting	(232) x	0.519	=	163.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1203.79	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.95	(273)
EI rating (section 14)				86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-202-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.44	(1a)	x	2.7	(2a)	=	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 10.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.64 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

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

(39)m=	47.04	46.89	46.75	46.04	45.89	45.18	45.18	45.03	45.46	45.89	46.18	46.47	

Average = $Sum(39)_{1...12}$ /12= 46 (39)

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

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.92	

Average = $Sum(40)_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.71	279.53	269.35	253.37	237.44	221.83	211.87	217.17	225.49	241.64	260.1	273.81	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

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

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

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

(84)m=	333.75	375.24	419.09	470.41	509.28	504.35	478.99	441.47	398.24	352.49	323.72	317.51	(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	0.92	0.77	0.57	0.41	0.47	0.74	0.95	0.99	1	(86)

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

(87)m=	20.12	20.26	20.48	20.76	20.94	20.99	21	21	20.96	20.72	20.38	20.1	(87)

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

(88)m=	20.14	20.14	20.14	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

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

(89)m=	1	0.99	0.97	0.9	0.72	0.5	0.34	0.38	0.67	0.93	0.99	1	(89)

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

(90)m=	18.97	19.17	19.49	19.88	20.1	20.17	20.17	20.17	20.14	19.85	19.35	18.94	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.6	19.76	20.03	20.36	20.55	20.62	20.62	20.62	20.59	20.32	19.91	19.57	(92)

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

(93)m=	19.45	19.61	19.88	20.21	20.4	20.47	20.47	20.47	20.44	20.17	19.76	19.42	(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	0.9	0.74	0.52	0.36	0.41	0.69	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	331.81	370.68	405.74	422.53	375.57	262.58	174.67	182.89	275.98	329.43	319.63	316.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	712.41	689.83	625.42	520.6	399.48	264.98	174.89	183.36	288.11	439.4	584.52	707.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	283.17	214.47	163.44	70.61	17.79	0	0	0	0	81.82	190.73	291	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1313.02 (98)

Space heating requirement in kWh/m²/year 26.03 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	283.17	214.47	163.44	70.61	17.79	0	0	0	0	81.82	190.73	291	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	313.59	237.51	181	78.19	19.7	0	0	0	0	90.61	211.21	322.26	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1454.07 (211)

DER WorkSheet: New dwelling design stage

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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 81 (216)

(217)m=	86.66	86.34	85.62	84.02	82.03	81	81	81	81	84.22	85.99	86.77	(217)

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

(219)m=	188.81	165.54	173.68	156.98	155.66	138.84	133.02	148.29	149.93	164.19	171.66	184.13

Total = Sum(219a)$_{1...12}$ = 1930.74 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1454.07	
Water heating fuel used			1930.74	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		157.84		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		187.84	(231)
Electricity for lighting			234.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3807.63	(338)

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	=	314.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	417.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =			731.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.49	(267)
Electricity for lighting	(232) x	0.519	=	121.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		950.56	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.85	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-301-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Total area of elements, m²			103.17							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(32a)
Party ceiling			71.04							(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) = 35.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 12.73 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.39 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

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

(39)m=	65.85	65.65	65.45	64.44	64.24	63.23	63.23	63.03	63.63	64.24	64.64	65.04	

Average = Sum(39)$_{1...12}$ /12= 64.39 (39)

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

(40)m=	0.93	0.92	0.92	0.91	0.9	0.89	0.89	0.89	0.9	0.9	0.91	0.92	

Average = Sum(40)$_{1...12}$ /12= 0.91 (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 2.27 (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 88.14 (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	
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95	

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

Total = Sum(44)$_{1...12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24	

Total = Sum(45)$_{1...12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1…12}$ — 1915.45 (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)

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

(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)

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

(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)

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

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)

Water heating gains (Table 5)

(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)

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

(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.15	348.1	(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)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest	0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest	0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest	0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest	0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

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

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

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

(84)m=	457.6	536.14	619.69	715.84	788.43	785.03	745.71	679.16	602.29	513.7	450.99	431.61	(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	0.97	0.89	0.72	0.51	0.37	0.43	0.7	0.95	0.99	1	(86)

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

(87)m=	20.11	20.28	20.52	20.81	20.96	21	21	21	20.97	20.75	20.38	20.09	(87)

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

(88)m=	20.14	20.15	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

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

(89)m=	1	0.99	0.96	0.87	0.67	0.45	0.3	0.35	0.63	0.92	0.99	1	(89)

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

(90)m=	18.96	19.2	19.55	19.95	20.13	20.17	20.18	20.18	20.15	19.88	19.35	18.93	(90)

fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.4	19.61	19.93	20.28	20.45	20.49	20.49	20.5	20.47	20.22	19.75	19.37	(92)

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

(93)m=	19.25	19.46	19.78	20.13	20.3	20.34	20.34	20.35	20.32	20.07	19.6	19.22	(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	0.96	0.86	0.67	0.46	0.32	0.37	0.64	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.11	528.73	594.11	618.32	531.92	361.34	236.59	248.34	385.06	473.06	445.17	429.9	(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=	984.78	956.07	868.87	723.52	552.26	362.98	236.72	248.64	395.76	608.03	807.92	977.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	394.07	287.17	204.42	75.74	15.13	0	0	0	0	100.42	261.18	407.2	(98)

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)1...5,9...12 =	1745.34	(98)
Space heating requirement in kWh/m²/year	24.57	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)	394.07	287.17	204.42	75.74	15.13	0	0	0	0	100.42	261.18	407.2		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	436.41	318.02	226.38	83.88	16.75	0	0	0	0	111.21	289.24	450.94		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													1932.82	(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)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65		
Efficiency of water heater													81	(216)
(217)m=	87.01	86.62	85.75	83.82	81.77	81	81	81	81	84.31	86.33	87.13		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	222.02	194.82	204.75	185.78	184.39	163.94	157.07	175.09	177.02	193.67	201.89	216.51		
Total = Sum(219a)1...12 =													2276.93	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1932.82	
Water heating fuel used			2276.93	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		222.31		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		252.31	(231)
Electricity for lighting			314.43	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4776.5	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x		0.216	=	417.49	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	491.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =				909.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	130.95	(267)
Electricity for lighting	(232) x		0.519	=	163.19	(268)
Total CO2, kg/year		sum of (265)…(271) =			1203.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			16.94	(273)
EI rating (section 14)					86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-302-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 10.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.64 (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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

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

(39)m=	47.04	46.89	46.75	46.04	45.89	45.18	45.18	45.03	45.46	45.89	46.18	46.47	

Average = Sum(39)$_{1...12}$ /12= 46 (39)

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

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.92	

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = Sum(44)$_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = Sum(45)$_{1...12}$ = 1174.5 (45)

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

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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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=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)1…12 | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

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

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

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

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

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

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)

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

(73)m=	281.71	279.53	269.35	253.37	237.44	221.83	211.87	217.17	225.49	241.64	260.1	273.81	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast	0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

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

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

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

(84)m=	333.75	375.24	419.09	470.41	509.28	504.35	478.99	441.47	398.24	352.49	323.72	317.51	(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

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(86)m=	1	0.99	0.98	0.92	0.77	0.57	0.41	0.47	0.74	0.95	0.99	1	(86)

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

(87)m=	20.12	20.26	20.48	20.76	20.94	20.99	21	21	20.96	20.72	20.38	20.1	(87)

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

(88)m=	20.14	20.14	20.14	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

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

(89)m=	1	0.99	0.97	0.9	0.72	0.5	0.34	0.38	0.67	0.93	0.99	1	(89)

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

(90)m=	18.97	19.17	19.49	19.88	20.1	20.17	20.17	20.17	20.14	19.85	19.35	18.94	(90)

fLA = Living area ÷ (4) = 0.54 (91)

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

(92)m=	19.6	19.76	20.03	20.36	20.55	20.62	20.62	20.62	20.59	20.32	19.91	19.57	(92)

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

(93)m=	19.45	19.61	19.88	20.21	20.4	20.47	20.47	20.47	20.44	20.17	19.76	19.42	(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	0.9	0.74	0.52	0.36	0.41	0.69	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	331.81	370.68	405.74	422.53	375.57	262.58	174.67	182.89	275.98	329.43	319.63	316.1	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	712.41	689.83	625.42	520.6	399.48	264.98	174.89	183.36	288.11	439.4	584.52	707.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	283.17	214.47	163.44	70.61	17.79	0	0	0	0	81.82	190.73	291	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1313.02 (98)

Space heating requirement in kWh/m²/year 26.03 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	283.17	214.47	163.44	70.61	17.79	0	0	0	0	81.82	190.73	291	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	313.59	237.51	181	78.19	19.7	0	0	0	0	90.61	211.21	322.26	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1454.07 (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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 81 (216)

(217)m=	86.66	86.34	85.62	84.02	82.03	81	81	81	81	84.22	85.99	86.77	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	188.81	165.54	173.68	156.98	155.66	138.84	133.02	148.29	149.93	164.19	171.66	184.13

Total = Sum(219a)$_{1...12}$ = 1930.74 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1454.07	
Water heating fuel used			1930.74	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		157.84		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		187.84	(231)
Electricity for lighting			234.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3807.63	(338)

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	=	314.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	417.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =			731.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.49	(267)
Electricity for lighting	(232) x	0.519	=	121.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		950.56	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.85	(273)
EI rating (section 14)				87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-401-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Roof	75.26	0	75.26	x	0.13	=	9.78			(30)
Total area of elements, m²			178.43							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(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) = 45.45 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 21732.64 (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 31.57 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 77.02 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

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

(39)m=	94.48	94.28	94.07	93.07	92.86	91.85	91.85	91.65	92.26	92.86	93.27	93.67	

Average = Sum(39)$_{1…12}$ /12= 93.01 (39)

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

(40)m=	1.33	1.33	1.32	1.31	1.31	1.29	1.29	1.29	1.3	1.31	1.31	1.32	

Average = Sum(40)$_{1…12}$ /12= 1.31 (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 2.27 (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 88.14 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95	

Total = Sum(44)$_{1…12}$ = 1057.67 (44)

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

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24	

Total = Sum(45)$_{1…12}$ = 1386.77 (45)

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

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(46)

Water storage loss:

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

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

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.41	43	45.81	42.6	42.22	39.12	40.42	42.22	42.6	45.81	46.07	49.41	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65	(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=	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65

Output from water heater (annual)$_{1...12}$ | 1915.45 | (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=	60.16	52.56	54.6	48.26	46.65	40.93	38.97	43.67	44.16	50.51	54.15	58.65	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(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=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)
Water heating gains (Table 5)													
(72)m=	80.86	78.22	73.39	67.03	62.7	56.84	52.37	58.7	61.34	67.89	75.21	78.83	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	358.44	355.88	342.88	322.28	301.45	281.27	268.49	274.73	285.55	306.34	330.15	348.1	(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)

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Northeast	0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast	0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast	0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast	0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast	0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast	0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast	0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast	0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast	0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast	0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast	0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast	0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast	0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast	0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast	0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast	0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast	0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast	0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast	0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast	0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast	0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast	0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast	0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast	0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest	0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest	0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest	0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest	0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest	0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest	0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest	0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest	0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest	0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest	0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest	0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest	0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest	0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest	0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest	0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest	0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest	0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest	0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest	0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest	0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest	0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	457.6	536.14	619.69	715.84	788.43	785.03	745.71	679.16	602.29	513.7	450.99	431.61	(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	0.85	0.69	0.53	0.59	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=	19.56	19.74	20.03	20.43	20.76	20.94	20.99	20.98	20.83	20.4	19.91	19.53	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.85	19.85	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.8	0.59	0.4	0.46	0.76	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=	17.92	18.18	18.61	19.17	19.6	19.81	19.84	19.84	19.71	19.15	18.44	17.89	(90)

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.56	18.78	19.16	19.66	20.05	20.24	20.28	20.28	20.14	19.63	19.01	18.52	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.41	18.63	19.01	19.51	19.9	20.09	20.13	20.13	19.99	19.48	18.86	18.37	(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	0.8	0.61	0.43	0.49	0.78	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	455.09	530.09	602.77	660.68	634.62	478.54	320.43	334.24	467.41	489.38	446.2	429.78	(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=	1332.83	1294.52	1176.71	987.03	761.32	504.55	324.53	341.66	543.81	824.79	1096.63	1327.5	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	653.04	513.7	427.01	234.97	94.26	0	0	0	0	249.55	468.31	667.9	

Total per year (kWh/year) = Sum(98)1...5,9...12 =	3308.74	(98)
Space heating requirement in kWh/m²/year	46.58	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)	653.04	513.7	427.01	234.97	94.26	0	0	0	0	249.55	468.31	667.9		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	723.19	568.88	472.88	260.21	104.39	0	0	0	0	276.35	518.62	739.65		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													3664.17	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	193.18	168.75	175.57	155.73	150.77	132.79	127.22	141.82	143.39	163.28	174.3	188.65		
Efficiency of water heater													81	(216)
(217)m=	87.99	87.81	87.38	86.35	84.34	81	81	81	81	86.38	87.57	88.07		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	219.54	192.18	200.94	180.35	178.76	163.94	157.07	175.09	177.02	189.03	199.03	214.19		
Total = Sum(219a)1...12 =													2247.15	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3664.17	
Water heating fuel used			2247.15	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		222.31		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		252.31	(231)
Electricity for lighting			314.43	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6478.05	(338)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	791.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	485.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1276.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	130.95	(267)
Electricity for lighting	(232) x	0.519	=	163.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1570.98	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.11	(273)
EI rating (section 14)				82	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-402-LEAN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.44	(1a)	x	2.7	(2a)	=	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	136.19	(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							0	x 10 =	0	(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) = 0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Roof	50.44	0	50.44	x	0.13	=	6.56			(30)
Total area of elements, m²			128.73							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(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) = 30.49 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17007.06 (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 24.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.81 (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

DER WorkSheet: New dwelling design stage

(38)m=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.21	67.06	66.92	66.2	66.06	65.34	65.34	65.2	65.63	66.06	66.35	66.63	

Average = $Sum(39)_{1...12}$ /12= 66.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.33	1.33	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.32	1.32	

Average = $Sum(40)_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	41.84	36.42	38.8	36.08	35.76	33.13	34.24	35.76	36.08	38.8	39.02	41.84	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77	(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=	163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Output from water heater (annual)$_{1...12}$ | 1622.26 | (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=	50.95	44.52	46.24	40.88	39.51	34.66	33	36.99	37.4	42.78	45.86	49.67	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(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=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)
Water heating gains (Table 5)													
(72)m=	68.48	66.24	62.15	56.77	53.1	48.14	44.36	49.72	51.95	57.5	63.7	66.76	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	281.71	279.53	269.35	253.37	237.44	221.83	211.87	217.17	225.49	241.64	260.1	273.81	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	333.75	375.24	419.09	470.41	509.28	504.35	478.99	441.47	398.24	352.49	323.72	317.51	(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	0.99	0.96	0.89	0.74	0.58	0.64	0.87	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.73	20	20.37	20.71	20.92	20.98	20.97	20.81	20.38	19.91	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.83	19.84	19.84	19.85	19.84	19.83	19.83	19.82	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.84	0.64	0.44	0.5	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=	17.94	18.16	18.55	19.09	19.54	19.79	19.84	19.83	19.68	19.12	18.44	17.91	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.83	19.01	19.34	19.79	20.18	20.4	20.46	20.45	20.29	19.8	19.24	18.8	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.68	18.86	19.19	19.64	20.03	20.25	20.31	20.3	20.14	19.65	19.09	18.65	(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	0.98	0.94	0.85	0.67	0.49	0.56	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	331.86	371.48	409.99	443.07	432.56	340.43	236.86	245.23	325.93	338.58	320.4	316.07	(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=	966.47	936.29	849.03	710.79	550.01	369.27	242.29	254.25	396.64	598.07	795.74	962.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	472.15	379.56	326.65	192.76	87.38	0	0	0	0	193.06	342.24	481.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2475.07 (98)

Space heating requirement in kWh/m²/year 49.07 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	472.15	379.56	326.65	192.76	87.38	0	0	0	0	193.06	342.24	481.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	522.87	420.33	361.74	213.47	96.77	0	0	0	0	213.8	379.01	532.97	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2740.95 (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)

163.61	142.92	148.7	131.89	127.69	112.46	107.75	120.12	121.44	138.29	147.62	159.77

Efficiency of water heater 81 (216)

(217)m=	87.71	87.55	87.17	86.28	84.54	81	81	81	81	86.17	87.28	87.79

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	186.54	163.24	170.59	152.87	151.05	138.84	133.02	148.29	149.93	160.48	169.13	182

Total = Sum(219a)$_{1...12}$ = 1905.99 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2740.95	
Water heating fuel used			1905.99	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		157.84		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		187.84	(231)
Electricity for lighting			234.98	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5069.75	(338)

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	=	592.04	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	411.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1003.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.49	(267)
Electricity for lighting	(232) x	0.519	=	121.95	(268)
Total CO2, kg/year		sum of (265)…(271) =		1223.18	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		24.25	(273)
EI rating (section 14)				83	(274)

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Be Green- DER from the Be Green scenario DER SAP worksheet

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: House- H01-GREEN

Address : West End Lane, LONDON, NW6 4NX

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	57.4	(1a)	x	2.1	(2a)	=	120.54	(3a)
Ground floor	53.06	(1b)	x	2.85	(2b)	=	151.22	(3b)
First floor	53.06	(1c)	x	3.08	(2c)	=	163.42	(3c)
Second floor	43.77	(1d)	x	2.26	(2d)	=	98.92	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	207.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	534.11	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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)	0.75	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling created by change of use

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.93	0.91	0.89	0.81	0.8	0.72	0.72	0.7	0.75	0.8	0.83	0.86	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.89	0.81	0.8	0.72	0.72	0.7	0.75	0.8	0.83	0.86	(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 Type 1			3.67	x	1.6	=	5.872			(26)
Doors Type 2			2.85	x	1.6	=	4.56			(26)
Doors Type 3			2.35	x	1	=	2.35			(26)
Windows Type 1			2.22		x1/[1/(1.6)+ 0.04]	=	3.34			(27)
Windows Type 2			1.13		x1/[1/(1.6)+ 0.04]	=	1.7			(27)
Windows Type 3			0.61		x1/[1/(1.6)+ 0.04]	=	0.92			(27)
Windows Type 4			2.25		x1/[1/(1.6)+ 0.04]	=	3.38			(27)
Windows Type 5			1.77		x1/[1/(1.6)+ 0.04]	=	2.66			(27)
Windows Type 6			1.31		x1/[1/(1.6)+ 0.04]	=	1.97			(27)
Windows Type 7			0.68		x1/[1/(1.6)+ 0.04]	=	1.02			(27)
Windows Type 8			2.69		x1/[1/(1.6)+ 0.04]	=	4.05			(27)
Windows Type 9			1.03		x1/[1/(1.6)+ 0.04]	=	1.55			(27)
Windows Type 10			2.9		x1/[1/(1.6)+ 0.04]	=	4.36			(27)
Rooflights			1.112034		x1/[1/(1.6) + 0.04]	=	1.779254			(27b)

DER WorkSheet: New dwelling created by change of use

Floor Type 1			57.4	x	0.25	=	14.35			(28)
Floor Type 2			53.06	x	0.25	=	13.265			(28)
Walls Type1	81.43	0	81.43	x	0.55	=	44.79			(29)
Walls Type2	15.31	6.41	8.9	x	0.15	=	1.34			(29)
Walls Type3	24.3	0	24.3	x	0.15	=	3.65			(29)
Walls Type4	101.44	33.57	67.87	x	0.55	=	37.33			(29)
Roof Type1	62.74	3.34	59.4	x	0.18	=	10.69			(30)
Roof Type2	10.96	0	10.96	x	0.18	=	1.97			(30)
Total area of elements, m²			406.64							(31)
Party wall			58.5	x	0	=	0			(32)

** 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) =	191.96	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39052.95	(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		61	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	252.95	(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=	163.22	160.41	157.6	143.56	140.75	126.71	126.71	123.9	132.32	140.75	146.37	151.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	416.18	413.37	410.56	396.51	393.7	379.66	379.66	376.85	385.28	393.7	399.32	404.94	
										Average = Sum(39)$_{1…12}$ /12=		395.81	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.01	1.99	1.98	1.91	1.9	1.83	1.83	1.82	1.86	1.9	1.93	1.95	
										Average = Sum(40)$_{1…12}$ /12=		1.91	(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	3.01	(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	105.72	(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=	116.29	112.06	107.84	103.61	99.38	95.15	95.15	99.38	103.61	107.84	112.06	116.29	
										Total = Sum(44)$_{1…12}$ =		1268.65	(44)

DER WorkSheet: New dwelling created by change of use

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=	172.46	150.83	155.65	135.7	130.2	112.36	104.11	119.47	120.9	140.9	153.8	167.02	

Total = Sum(45)$_{1...12}$ = 1663.4 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.87	22.63	23.35	20.35	19.53	16.85	15.62	17.92	18.14	21.13	23.07	25.05	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	227.74	200.76	210.92	189.19	185.48	165.85	159.39	174.75	174.39	196.17	207.29	222.29	(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=	227.74	200.76	210.92	189.19	185.48	165.85	159.39	174.75	174.39	196.17	207.29	222.29

Output from water heater (annual)$_{1...12}$ 2314.24 (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=	101.56	90.09	95.97	87.91	87.51	80.15	78.84	83.95	82.99	91.07	93.93	99.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(66)m=	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	150.57	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	33.69	29.92	24.34	18.42	13.77	11.63	12.56	16.33	21.92	27.83	32.48	34.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	377.92	381.84	371.96	350.92	324.37	299.41	282.73	278.81	288.69	309.73	336.29	361.25	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	38.06	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	-120.46	(71)

Water heating gains (Table 5)

(72)m=	136.51	134.07	129	122.1	117.63	111.32	105.97	112.83	115.27	122.41	130.46	134.08	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	616.3	614.01	593.47	559.62	523.94	490.53	469.43	476.14	494.05	528.14	567.4	598.13	(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	0.68	x	11.28	x	0.55	x	0.8	=	7.02	(75)
Northeast	0.9x	0.77	x	0.68	x	22.97	x	0.55	x	0.8	=	14.29	(75)
Northeast	0.9x	0.77	x	0.68	x	41.38	x	0.55	x	0.8	=	25.74	(75)
Northeast	0.9x	0.77	x	0.68	x	67.96	x	0.55	x	0.8	=	42.27	(75)
Northeast	0.9x	0.77	x	0.68	x	91.35	x	0.55	x	0.8	=	56.82	(75)
Northeast	0.9x	0.77	x	0.68	x	97.38	x	0.55	x	0.8	=	60.58	(75)
Northeast	0.9x	0.77	x	0.68	x	91.1	x	0.55	x	0.8	=	56.67	(75)
Northeast	0.9x	0.77	x	0.68	x	72.63	x	0.55	x	0.8	=	45.18	(75)
Northeast	0.9x	0.77	x	0.68	x	50.42	x	0.55	x	0.8	=	31.36	(75)
Northeast	0.9x	0.77	x	0.68	x	28.07	x	0.55	x	0.8	=	17.46	(75)
Northeast	0.9x	0.77	x	0.68	x	14.2	x	0.55	x	0.8	=	8.83	(75)
Northeast	0.9x	0.77	x	0.68	x	9.21	x	0.55	x	0.8	=	5.73	(75)
Southeast	0.9x	0.77	x	2.69	x	36.79	x	0.55	x	0.8	=	60.36	(77)
Southeast	0.9x	0.77	x	1.03	x	36.79	x	0.55	x	0.8	=	11.56	(77)
Southeast	0.9x	0.77	x	2.69	x	62.67	x	0.55	x	0.8	=	102.81	(77)
Southeast	0.9x	0.77	x	1.03	x	62.67	x	0.55	x	0.8	=	19.68	(77)
Southeast	0.9x	0.77	x	2.69	x	85.75	x	0.55	x	0.8	=	140.67	(77)
Southeast	0.9x	0.77	x	1.03	x	85.75	x	0.55	x	0.8	=	26.93	(77)
Southeast	0.9x	0.77	x	2.69	x	106.25	x	0.55	x	0.8	=	174.3	(77)
Southeast	0.9x	0.77	x	1.03	x	106.25	x	0.55	x	0.8	=	33.37	(77)
Southeast	0.9x	0.77	x	2.69	x	119.01	x	0.55	x	0.8	=	195.23	(77)

DER WorkSheet: New dwelling created by change of use

Southeast	0.9x	0.77	x	1.03	x	119.01	x	0.55	x	0.8	=	37.38	(77)
Southeast	0.9x	0.77	x	2.69	x	118.15	x	0.55	x	0.8	=	193.82	(77)
Southeast	0.9x	0.77	x	1.03	x	118.15	x	0.55	x	0.8	=	37.11	(77)
Southeast	0.9x	0.77	x	2.69	x	113.91	x	0.55	x	0.8	=	186.86	(77)
Southeast	0.9x	0.77	x	1.03	x	113.91	x	0.55	x	0.8	=	35.78	(77)
Southeast	0.9x	0.77	x	2.69	x	104.39	x	0.55	x	0.8	=	171.25	(77)
Southeast	0.9x	0.77	x	1.03	x	104.39	x	0.55	x	0.8	=	32.79	(77)
Southeast	0.9x	0.77	x	2.69	x	92.85	x	0.55	x	0.8	=	152.32	(77)
Southeast	0.9x	0.77	x	1.03	x	92.85	x	0.55	x	0.8	=	29.16	(77)
Southeast	0.9x	0.77	x	2.69	x	69.27	x	0.55	x	0.8	=	113.63	(77)
Southeast	0.9x	0.77	x	1.03	x	69.27	x	0.55	x	0.8	=	21.75	(77)
Southeast	0.9x	0.77	x	2.69	x	44.07	x	0.55	x	0.8	=	72.3	(77)
Southeast	0.9x	0.77	x	1.03	x	44.07	x	0.55	x	0.8	=	13.84	(77)
Southeast	0.9x	0.77	x	2.69	x	31.49	x	0.55	x	0.8	=	51.65	(77)
Southeast	0.9x	0.77	x	1.03	x	31.49	x	0.55	x	0.8	=	9.89	(77)
Southwest	0.9x	0.77	x	2.22	x	36.79		0.55	x	0.8	=	49.81	(79)
Southwest	0.9x	0.77	x	1.13	x	36.79		0.55	x	0.8	=	25.36	(79)
Southwest	0.9x	0.77	x	0.61	x	36.79		0.55	x	0.8	=	6.84	(79)
Southwest	0.9x	0.77	x	2.22	x	62.67		0.55	x	0.8	=	84.85	(79)
Southwest	0.9x	0.77	x	1.13	x	62.67		0.55	x	0.8	=	43.19	(79)
Southwest	0.9x	0.77	x	0.61	x	62.67		0.55	x	0.8	=	11.66	(79)
Southwest	0.9x	0.77	x	2.22	x	85.75		0.55	x	0.8	=	116.1	(79)
Southwest	0.9x	0.77	x	1.13	x	85.75		0.55	x	0.8	=	59.09	(79)
Southwest	0.9x	0.77	x	0.61	x	85.75		0.55	x	0.8	=	15.95	(79)
Southwest	0.9x	0.77	x	2.22	x	106.25		0.55	x	0.8	=	143.85	(79)
Southwest	0.9x	0.77	x	1.13	x	106.25		0.55	x	0.8	=	73.22	(79)
Southwest	0.9x	0.77	x	0.61	x	106.25		0.55	x	0.8	=	19.76	(79)
Southwest	0.9x	0.77	x	2.22	x	119.01		0.55	x	0.8	=	161.12	(79)
Southwest	0.9x	0.77	x	1.13	x	119.01		0.55	x	0.8	=	82.01	(79)
Southwest	0.9x	0.77	x	0.61	x	119.01		0.55	x	0.8	=	22.14	(79)
Southwest	0.9x	0.77	x	2.22	x	118.15		0.55	x	0.8	=	159.96	(79)
Southwest	0.9x	0.77	x	1.13	x	118.15		0.55	x	0.8	=	81.42	(79)
Southwest	0.9x	0.77	x	0.61	x	118.15		0.55	x	0.8	=	21.98	(79)
Southwest	0.9x	0.77	x	2.22	x	113.91		0.55	x	0.8	=	154.22	(79)
Southwest	0.9x	0.77	x	1.13	x	113.91		0.55	x	0.8	=	78.5	(79)
Southwest	0.9x	0.77	x	0.61	x	113.91		0.55	x	0.8	=	21.19	(79)
Southwest	0.9x	0.77	x	2.22	x	104.39		0.55	x	0.8	=	141.33	(79)
Southwest	0.9x	0.77	x	1.13	x	104.39		0.55	x	0.8	=	71.94	(79)
Southwest	0.9x	0.77	x	0.61	x	104.39		0.55	x	0.8	=	19.42	(79)
Southwest	0.9x	0.77	x	2.22	x	92.85		0.55	x	0.8	=	125.71	(79)
Southwest	0.9x	0.77	x	1.13	x	92.85		0.55	x	0.8	=	63.99	(79)

DER WorkSheet: New dwelling created by change of use

Southwest	0.9x	0.77	x	0.61	x	92.85		0.55	x	0.8	=	17.27	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27		0.55	x	0.8	=	93.78	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.55	x	0.8	=	47.73	(79)
Southwest	0.9x	0.77	x	0.61	x	69.27		0.55	x	0.8	=	12.88	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07		0.55	x	0.8	=	59.66	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.55	x	0.8	=	30.37	(79)
Southwest	0.9x	0.77	x	0.61	x	44.07		0.55	x	0.8	=	8.2	(79)
Southwest	0.9x	0.77	x	2.22	x	31.49		0.55	x	0.8	=	42.63	(79)
Southwest	0.9x	0.77	x	1.13	x	31.49		0.55	x	0.8	=	21.7	(79)
Southwest	0.9x	0.77	x	0.61	x	31.49		0.55	x	0.8	=	5.86	(79)
Northwest	0.9x	0.77	x	2.25	x	11.28	x	0.55	x	0.8	=	23.22	(81)
Northwest	0.9x	0.77	x	1.77	x	11.28	x	0.55	x	0.8	=	6.09	(81)
Northwest	0.9x	0.77	x	1.31	x	11.28	x	0.55	x	0.8	=	13.52	(81)
Northwest	0.9x	0.77	x	2.9	x	11.28	x	0.55	x	0.8	=	9.98	(81)
Northwest	0.9x	0.77	x	2.25	x	22.97	x	0.55	x	0.8	=	47.27	(81)
Northwest	0.9x	0.77	x	1.77	x	22.97	x	0.55	x	0.8	=	12.4	(81)
Northwest	0.9x	0.77	x	1.31	x	22.97	x	0.55	x	0.8	=	27.52	(81)
Northwest	0.9x	0.77	x	2.9	x	22.97	x	0.55	x	0.8	=	20.31	(81)
Northwest	0.9x	0.77	x	2.25	x	41.38	x	0.55	x	0.8	=	85.17	(81)
Northwest	0.9x	0.77	x	1.77	x	41.38	x	0.55	x	0.8	=	22.33	(81)
Northwest	0.9x	0.77	x	1.31	x	41.38	x	0.55	x	0.8	=	49.59	(81)
Northwest	0.9x	0.77	x	2.9	x	41.38	x	0.55	x	0.8	=	36.59	(81)
Northwest	0.9x	0.77	x	2.25	x	67.96	x	0.55	x	0.8	=	139.87	(81)
Northwest	0.9x	0.77	x	1.77	x	67.96	x	0.55	x	0.8	=	36.68	(81)
Northwest	0.9x	0.77	x	1.31	x	67.96	x	0.55	x	0.8	=	81.43	(81)
Northwest	0.9x	0.77	x	2.9	x	67.96	x	0.55	x	0.8	=	60.09	(81)
Northwest	0.9x	0.77	x	2.25	x	91.35	x	0.55	x	0.8	=	188.01	(81)
Northwest	0.9x	0.77	x	1.77	x	91.35	x	0.55	x	0.8	=	49.3	(81)
Northwest	0.9x	0.77	x	1.31	x	91.35	x	0.55	x	0.8	=	109.46	(81)
Northwest	0.9x	0.77	x	2.9	x	91.35	x	0.55	x	0.8	=	80.77	(81)
Northwest	0.9x	0.77	x	2.25	x	97.38	x	0.55	x	0.8	=	200.44	(81)
Northwest	0.9x	0.77	x	1.77	x	97.38	x	0.55	x	0.8	=	52.56	(81)
Northwest	0.9x	0.77	x	1.31	x	97.38	x	0.55	x	0.8	=	116.7	(81)
Northwest	0.9x	0.77	x	2.9	x	97.38	x	0.55	x	0.8	=	86.11	(81)
Northwest	0.9x	0.77	x	2.25	x	91.1	x	0.55	x	0.8	=	187.51	(81)
Northwest	0.9x	0.77	x	1.77	x	91.1	x	0.55	x	0.8	=	49.17	(81)
Northwest	0.9x	0.77	x	1.31	x	91.1	x	0.55	x	0.8	=	109.17	(81)
Northwest	0.9x	0.77	x	2.9	x	91.1	x	0.55	x	0.8	=	80.56	(81)
Northwest	0.9x	0.77	x	2.25	x	72.63	x	0.55	x	0.8	=	149.48	(81)
Northwest	0.9x	0.77	x	1.77	x	72.63	x	0.55	x	0.8	=	39.2	(81)
Northwest	0.9x	0.77	x	1.31	x	72.63	x	0.55	x	0.8	=	87.03	(81)

Northwest	0.9x	0.77	x	2.9	x	72.63	x	0.55	x	0.8	=	64.22	(81)
Northwest	0.9x	0.77	x	2.25	x	50.42	x	0.55	x	0.8	=	103.78	(81)
Northwest	0.9x	0.77	x	1.77	x	50.42	x	0.55	x	0.8	=	27.21	(81)
Northwest	0.9x	0.77	x	1.31	x	50.42	x	0.55	x	0.8	=	60.42	(81)
Northwest	0.9x	0.77	x	2.9	x	50.42	x	0.55	x	0.8	=	44.59	(81)
Northwest	0.9x	0.77	x	2.25	x	28.07	x	0.55	x	0.8	=	57.77	(81)
Northwest	0.9x	0.77	x	1.77	x	28.07	x	0.55	x	0.8	=	15.15	(81)
Northwest	0.9x	0.77	x	1.31	x	28.07	x	0.55	x	0.8	=	33.63	(81)
Northwest	0.9x	0.77	x	2.9	x	28.07	x	0.55	x	0.8	=	24.82	(81)
Northwest	0.9x	0.77	x	2.25	x	14.2	x	0.55	x	0.8	=	29.22	(81)
Northwest	0.9x	0.77	x	1.77	x	14.2	x	0.55	x	0.8	=	7.66	(81)
Northwest	0.9x	0.77	x	1.31	x	14.2	x	0.55	x	0.8	=	17.01	(81)
Northwest	0.9x	0.77	x	2.9	x	14.2	x	0.55	x	0.8	=	12.55	(81)
Northwest	0.9x	0.77	x	2.25	x	9.21	x	0.55	x	0.8	=	18.96	(81)
Northwest	0.9x	0.77	x	1.77	x	9.21	x	0.55	x	0.8	=	4.97	(81)
Northwest	0.9x	0.77	x	1.31	x	9.21	x	0.55	x	0.8	=	11.04	(81)
Northwest	0.9x	0.77	x	2.9	x	9.21	x	0.55	x	0.8	=	8.15	(81)
Rooflights	0.9x	1	x	1.11	x	37.03	x	0.55	x	0.8	=	48.92	(82)
Rooflights	0.9x	1	x	1.11	x	70.28	x	0.55	x	0.8	=	92.85	(82)
Rooflights	0.9x	1	x	1.11	x	111.87	x	0.55	x	0.8	=	147.79	(82)
Rooflights	0.9x	1	x	1.11	x	159.33	x	0.55	x	0.8	=	210.48	(82)
Rooflights	0.9x	1	x	1.11	x	193.3	x	0.55	x	0.8	=	255.37	(82)
Rooflights	0.9x	1	x	1.11	x	197.35	x	0.55	x	0.8	=	260.71	(82)
Rooflights	0.9x	1	x	1.11	x	188.08	x	0.55	x	0.8	=	248.47	(82)
Rooflights	0.9x	1	x	1.11	x	162.62	x	0.55	x	0.8	=	214.83	(82)
Rooflights	0.9x	1	x	1.11	x	128.66	x	0.55	x	0.8	=	169.98	(82)
Rooflights	0.9x	1	x	1.11	x	82.24	x	0.55	x	0.8	=	108.65	(82)
Rooflights	0.9x	1	x	1.11	x	45.75	x	0.55	x	0.8	=	60.44	(82)
Rooflights	0.9x	1	x	1.11	x	30.74	x	0.55	x	0.8	=	40.61	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	262.68	476.83	725.95	1015.33	1237.62	1271.38	1208.08	1036.66	825.78	547.26	320.09	221.2	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	878.97	1090.84	1319.42	1574.95	1761.55	1761.91	1677.51	1512.8	1319.83	1075.4	887.49	819.33	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.99	0.96	0.88	0.78	0.83	0.95	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.62	18.81	19.17	19.71	20.21	20.65	20.85	20.81	20.44	19.79	19.15	18.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.33	19.34	19.35	19.39	19.4	19.45	19.45	19.46	19.43	19.4	19.38	19.36	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.8	0.59	0.66	0.91	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.24	16.53	17.06	17.86	18.59	19.19	19.39	19.37	18.93	18	17.05	16.28	(90)

fLA = Living area ÷ (4) = 0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.65	16.92	17.42	18.18	18.87	19.44	19.64	19.62	19.19	18.31	17.41	16.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.65	16.92	17.42	18.18	18.87	19.44	19.64	19.62	19.19	18.31	17.41	16.69	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.97	0.92	0.8	0.62	0.69	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	876.85	1085.3	1303.65	1524.33	1611.94	1401.04	1036.84	1039.23	1189.4	1055.56	883.73	817.84	(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=	5139.91	4969.51	4484.75	3680.08	2820.91	1837.37	1155.15	1212.2	1960.42	3033.89	4115.65	5056.44	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3171.72	2610.19	2366.74	1552.14	899.47	0	0	0	0	1471.87	2326.98	3153.52	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 17552.63 (98)

Space heating requirement in kWh/m²/year 84.68 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)

Space heating	**kWh/year**
Annual space heating requirement	17552.63

DER WorkSheet: New dwelling created by change of use

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	18430.27	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2314.24	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1943.96	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	485.99	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	184.3	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	24.3	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		716.77	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	716.77	(331)
Energy for lighting (calculated in Appendix L)		595.01	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		19165.7	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	3416.18	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	95.65	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	360.33	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	252.23	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	12.61	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	4137	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)

DER WorkSheet: New dwelling created by change of use

Total CO2 associated with space and water heating	(373) + (374) + (375) =			4137	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	372	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	308.81	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			4518.69	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			21.8	(384)
EI rating (section 14)				76	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Chris Hocknell
Stroma Number: STRO016363
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.51

Property Address: Flat-G01-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	81.64	(1a) x	2.7	(2a) =	220.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.64	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	220.43	(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							0	x 10 =	0	(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) = 0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.34	x1/[1/(1.4)+ 0.04]		=	5.75			(27)
Windows Type 3			5.76	x1/[1/(1.4)+ 0.04]		=	7.64			(27)
Windows Type 4			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Floor			81.64	x	0.13	=	10.6132			(28)
Walls Type1	79.62	16.14	63.48	x	0.15	=	9.52			(29)
Walls Type2	53.08	1.99	51.09	x	0.15	=	7.66			(29)
Roof Type1	4.85	0	4.85	x	0.13	=	0.63			(30)
Roof Type2	1.55	0	1.55	x	0.13	=	0.2			(30)
Total area of elements, m²			220.74							(31)
Party ceiling			75.24							(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) = 52.02 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 30206.1 (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 21.51 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 73.53 (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=	20.06	19.83	19.6	18.44	18.21	17.05	17.05	16.82	17.51	18.21	18.67	19.14	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	93.59	93.36	93.13	91.97	91.74	90.58	90.58	90.35	91.04	91.74	92.2	92.67	

Average = $Sum(39)_{1...12}$ /12= 91.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.14	1.14	1.13	1.12	1.11	1.11	1.11	1.12	1.12	1.13	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (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 93.41 (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=	102.76	99.02	95.28	91.55	87.81	84.07	84.07	87.81	91.55	95.28	99.02	102.76	

Total = $Sum(44)_{1...12}$ = 1120.97 (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=	152.38	133.28	137.53	119.9	115.05	99.28	92	105.57	106.83	124.5	135.9	147.58	

Total = $Sum(45)_{1...12}$ = 1469.77 (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	15.83	16.02	18.67	20.38	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) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	207.66	183.2	192.81	173.39	170.32	152.77	147.27	160.84	160.32	179.77	189.39	202.85	(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=	207.66	183.2	192.81	173.39	170.32	152.77	147.27	160.84	160.32	179.77	189.39	202.85

Output from water heater (annual)$_{1...12}$ | 2120.61 | (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=	94.89	84.26	89.95	82.66	82.47	75.8	74.81	79.32	78.31	85.62	87.98	93.29	(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=	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	124.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	19.86	17.64	14.35	10.86	8.12	6.85	7.41	9.63	12.92	16.41	19.15	20.41	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	222.83	225.15	219.32	206.91	191.26	176.54	166.71	164.39	170.22	182.63	198.28	213	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	-99.73	(71)

Water heating gains (Table 5)

(72)m=	127.54	125.38	120.9	114.81	110.85	105.28	100.55	106.62	108.77	115.08	122.2	125.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	430.63	428.57	414.97	392.98	370.63	349.08	335.06	341.04	352.31	374.51	400.03	419.21	(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	0.77	x	1.65	x	11.28	x	0.55	x	0.8	=	11.35	(75)
Northeast	0.9x	0.77	x	1.65	x	22.97	x	0.55	x	0.8	=	23.11	(75)
Northeast	0.9x	0.77	x	1.65	x	41.38	x	0.55	x	0.8	=	41.64	(75)
Northeast	0.9x	0.77	x	1.65	x	67.96	x	0.55	x	0.8	=	68.38	(75)
Northeast	0.9x	0.77	x	1.65	x	91.35	x	0.55	x	0.8	=	91.92	(75)
Northeast	0.9x	0.77	x	1.65	x	97.38	x	0.55	x	0.8	=	97.99	(75)
Northeast	0.9x	0.77	x	1.65	x	91.1	x	0.55	x	0.8	=	91.67	(75)
Northeast	0.9x	0.77	x	1.65	x	72.63	x	0.55	x	0.8	=	73.08	(75)
Northeast	0.9x	0.77	x	1.65	x	50.42	x	0.55	x	0.8	=	50.74	(75)
Northeast	0.9x	0.77	x	1.65	x	28.07	x	0.55	x	0.8	=	28.24	(75)
Northeast	0.9x	0.77	x	1.65	x	14.2	x	0.55	x	0.8	=	14.29	(75)
Northeast	0.9x	0.77	x	1.65	x	9.21	x	0.55	x	0.8	=	9.27	(75)
Southeast	0.9x	0.77	x	5.76	x	36.79	x	0.55	x	0.8	=	64.62	(77)
Southeast	0.9x	0.77	x	5.76	x	62.67	x	0.55	x	0.8	=	110.08	(77)
Southeast	0.9x	0.77	x	5.76	x	85.75	x	0.55	x	0.8	=	150.61	(77)
Southeast	0.9x	0.77	x	5.76	x	106.25	x	0.55	x	0.8	=	186.61	(77)
Southeast	0.9x	0.77	x	5.76	x	119.01	x	0.55	x	0.8	=	209.02	(77)
Southeast	0.9x	0.77	x	5.76	x	118.15	x	0.55	x	0.8	=	207.51	(77)
Southeast	0.9x	0.77	x	5.76	x	113.91	x	0.55	x	0.8	=	200.06	(77)
Southeast	0.9x	0.77	x	5.76	x	104.39	x	0.55	x	0.8	=	183.35	(77)
Southeast	0.9x	0.77	x	5.76	x	92.85	x	0.55	x	0.8	=	163.08	(77)
Southeast	0.9x	0.77	x	5.76	x	69.27	x	0.55	x	0.8	=	121.66	(77)
Southeast	0.9x	0.77	x	5.76	x	44.07	x	0.55	x	0.8	=	77.4	(77)
Southeast	0.9x	0.77	x	5.76	x	31.49	x	0.55	x	0.8	=	55.3	(77)
Southwest	0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest	0.9x	0.77	x	4.34	x	36.79		0.55	x	0.8	=	48.69	(79)
Southwest	0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest	0.9x	0.77	x	4.34	x	62.67		0.55	x	0.8	=	82.94	(79)
Southwest	0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest	0.9x	0.77	x	4.34	x	85.75		0.55	x	0.8	=	113.48	(79)
Southwest	0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest	0.9x	0.77	x	4.34	x	106.25		0.55	x	0.8	=	140.61	(79)
Southwest	0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest	0.9x	0.77	x	4.34	x	119.01		0.55	x	0.8	=	157.49	(79)
Southwest	0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest	0.9x	0.77	x	4.34	x	118.15		0.55	x	0.8	=	156.35	(79)
Southwest	0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest	0.9x	0.77	x	4.34	x	113.91		0.55	x	0.8	=	150.74	(79)
Southwest	0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)

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Southwest	0.9x	0.77	x	4.34	x	104.39		0.55	x	0.8	=	138.15	(79)
Southwest	0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest	0.9x	0.77	x	4.34	x	92.85		0.55	x	0.8	=	122.88	(79)
Southwest	0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest	0.9x	0.77	x	4.34	x	69.27		0.55	x	0.8	=	91.67	(79)
Southwest	0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest	0.9x	0.77	x	4.34	x	44.07		0.55	x	0.8	=	58.32	(79)
Southwest	0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)
Southwest	0.9x	0.77	x	4.34	x	31.49		0.55	x	0.8	=	41.67	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	155.41	268.49	377.37	484.37	557.86	560.57	537.64	481.79	414.27	299.44	186.83	132.55	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	586.04	697.06	792.34	877.36	928.49	909.65	872.71	822.82	766.58	673.94	586.86	551.76	(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	0.97	0.92	0.8	0.61	0.45	0.5	0.74	0.94	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	20.06	20.33	20.64	20.87	20.97	21	20.99	20.93	20.63	20.19	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	20	19.99	19.98	19.98	19.97	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.89	0.74	0.53	0.35	0.39	0.66	0.92	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.47	18.75	19.14	19.58	19.86	19.98	19.99	19.99	19.94	19.57	18.95	18.43	(90)

fLA = Living area ÷ (4) = 0.34 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.94	19.19	19.54	19.94	20.2	20.31	20.33	20.33	20.27	19.93	19.37	18.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.94	19.19	19.54	19.94	20.2	20.31	20.33	20.33	20.27	19.93	19.37	18.9	(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	0.96	0.89	0.76	0.56	0.39	0.43	0.69	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	581.37	684.25	757.98	781.54	702.05	505.01	336.24	352.37	526.48	619.1	576.72	548.41	(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=	1370.58	1334.34	1214.23	1015.13	779.98	517.45	337.78	354.97	562.08	855.92	1130.91	1362.59	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	587.17	436.86	339.45	168.18	57.98	0	0	0	0	176.19	399.02	605.74

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2770.59	(98)
Space heating requirement in kWh/m²/year	33.94	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2770.59	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2909.12	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2120.61	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1781.32	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	445.33	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.09	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	22.27	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		295.81	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	295.81	(331)
Energy for lighting (calculated in Appendix L)		350.77	(332)

DER WorkSheet: New dwelling design stage

Electricity generated by PVs (Appendix M) (negative quantity)				-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =				2979.37	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	= 539.23	(367)
Electrical energy for heat distribution	[(313) x		0.52	= 15.1	(372)
Water heating from separate community system					
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	= 330.18	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	= 231.13	(368)
Electrical energy for heat distribution	[(313) x		0.52	= 11.56	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)			= 1127.19	(373)
CO2 associated with space heating (secondary)	(309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			1127.19	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	= 153.53	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	= 182.05	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)...(382) =			1163.64	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.25	(384)
EI rating (section 14)				87.69	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-101-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	79.31	(1a) x	2.63	(2a) =	208.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	208.59	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.35	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.81	x1/[1/(1.4)+ 0.04]		=	7.7			(27)
Windows Type 4			4.37	x1/[1/(1.4)+ 0.04]		=	5.79			(27)
Windows Type 5			4.16	x1/[1/(1.4)+ 0.04]		=	5.52			(27)
Rooflights			3.06414	x1/[1/(1.4) + 0.04]		=	4.289796			(27b)
Floor			55.4	x	0.13	=	7.202			(28)
Walls Type1	70.84	17.98	52.86	x	0.15	=	7.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Roof Type1	5.84	3.06	2.78	x	0.13	=	0.36			(30)
Roof Type2	0.17	0	0.17	x	0.13	=	0.02			(30)
Total area of elements, m²			160.16							(31)
Party wall			17.81	x	0	=	0			(32)
Party floor			23.91							(32a)
Party ceiling			70.27							(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) =	49.29	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	25420.01	(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 | 24.58 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = | 73.87 | (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=	18.99	18.77	18.55	17.45	17.23	16.13	16.13	15.91	16.57	17.23	17.67	18.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	92.86	92.64	92.42	91.32	91.1	90	90	89.78	90.44	91.1	91.54	91.98	

Average = Sum(39)1…12 /12= | 91.27 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.17	1.17	1.17	1.15	1.15	1.13	1.13	1.13	1.14	1.15	1.15	1.16	

Average = Sum(40)1…12 /12= | 1.15 | (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 | 2.45 | (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 | 92.38 | (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=	101.62	97.92	94.23	90.53	86.84	83.14	83.14	86.84	90.53	94.23	97.92	101.62	

Total = Sum(44)1…12 = | 1108.55 | (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=	150.69	131.8	136	118.57	113.77	98.18	90.98	104.4	105.64	123.12	134.39	145.94	

Total = Sum(45)1…12 = | 1453.48 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.6	19.77	20.4	17.79	17.07	14.73	13.65	15.66	15.85	18.47	20.16	21.89	(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) = | 110 | (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	205.97	181.73	191.28	172.07	169.05	151.67	146.25	159.67	159.14	178.39	187.88	201.22	(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=	205.97	181.73	191.28	172.07	169.05	151.67	146.25	159.67	159.14	178.39	187.88	201.22

Output from water heater (annual)$_{1...12}$ — 2104.32 (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=	94.33	83.76	89.44	82.22	82.05	75.44	74.47	78.93	77.92	85.16	87.48	92.75	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	122.48	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.43	17.26	14.04	10.63	7.94	6.71	7.25	9.42	12.64	16.05	18.74	19.97	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	217.99	220.25	214.55	202.42	187.1	172.7	163.08	160.82	166.52	178.66	193.98	208.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	35.25	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	-97.99	(71)
Water heating gains (Table 5)													
(72)m=	126.78	124.65	120.22	114.19	110.28	104.78	100.1	106.09	108.22	114.46	121.5	124.66	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	423.96	421.91	408.56	386.99	365.07	343.93	330.17	336.08	347.13	368.92	393.96	412.75	(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	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast	0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast	0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast	0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast	0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast	0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast	0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast	0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast	0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast	0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast	0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast	0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast	0.9x	0.77	x	5.81	x	36.79	x	0.55	x	0.8	=	65.18	(77)
Southeast	0.9x	0.77	x	5.81	x	62.67	x	0.55	x	0.8	=	111.03	(77)
Southeast	0.9x	0.77	x	5.81	x	85.75	x	0.55	x	0.8	=	151.92	(77)
Southeast	0.9x	0.77	x	5.81	x	106.25	x	0.55	x	0.8	=	188.23	(77)
Southeast	0.9x	0.77	x	5.81	x	119.01	x	0.55	x	0.8	=	210.84	(77)
Southeast	0.9x	0.77	x	5.81	x	118.15	x	0.55	x	0.8	=	209.31	(77)
Southeast	0.9x	0.77	x	5.81	x	113.91	x	0.55	x	0.8	=	201.8	(77)
Southeast	0.9x	0.77	x	5.81	x	104.39	x	0.55	x	0.8	=	184.94	(77)
Southeast	0.9x	0.77	x	5.81	x	92.85	x	0.55	x	0.8	=	164.5	(77)
Southeast	0.9x	0.77	x	5.81	x	69.27	x	0.55	x	0.8	=	122.71	(77)
Southeast	0.9x	0.77	x	5.81	x	44.07	x	0.55	x	0.8	=	78.07	(77)
Southeast	0.9x	0.77	x	5.81	x	31.49	x	0.55	x	0.8	=	55.78	(77)
Southwest	0.9x	0.77	x	4.16	x	36.79		0.55	x	0.8	=	46.67	(79)
Southwest	0.9x	0.77	x	4.16	x	62.67		0.55	x	0.8	=	79.5	(79)
Southwest	0.9x	0.77	x	4.16	x	85.75		0.55	x	0.8	=	108.77	(79)
Southwest	0.9x	0.77	x	4.16	x	106.25		0.55	x	0.8	=	134.78	(79)
Southwest	0.9x	0.77	x	4.16	x	119.01		0.55	x	0.8	=	150.96	(79)
Southwest	0.9x	0.77	x	4.16	x	118.15		0.55	x	0.8	=	149.87	(79)
Southwest	0.9x	0.77	x	4.16	x	113.91		0.55	x	0.8	=	144.49	(79)
Southwest	0.9x	0.77	x	4.16	x	104.39		0.55	x	0.8	=	132.42	(79)
Southwest	0.9x	0.77	x	4.16	x	92.85		0.55	x	0.8	=	117.78	(79)
Southwest	0.9x	0.77	x	4.16	x	69.27		0.55	x	0.8	=	87.86	(79)
Southwest	0.9x	0.77	x	4.16	x	44.07		0.55	x	0.8	=	55.9	(79)
Southwest	0.9x	0.77	x	4.16	x	31.49		0.55	x	0.8	=	39.94	(79)
Northwest	0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	9.43	(81)
Northwest	0.9x	0.77	x	4.37	x	11.28	x	0.55	x	0.8	=	15.03	(81)
Northwest	0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	19.19	(81)

Northwest	0.9x	0.77	x	4.37	x	22.97	x	0.55	x	0.8	=	30.6	(81)
Northwest	0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	34.57	(81)
Northwest	0.9x	0.77	x	4.37	x	41.38	x	0.55	x	0.8	=	55.14	(81)
Northwest	0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	56.78	(81)
Northwest	0.9x	0.77	x	4.37	x	67.96	x	0.55	x	0.8	=	90.55	(81)
Northwest	0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	76.32	(81)
Northwest	0.9x	0.77	x	4.37	x	91.35	x	0.55	x	0.8	=	121.72	(81)
Northwest	0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	81.36	(81)
Northwest	0.9x	0.77	x	4.37	x	97.38	x	0.55	x	0.8	=	129.76	(81)
Northwest	0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	76.11	(81)
Northwest	0.9x	0.77	x	4.37	x	91.1	x	0.55	x	0.8	=	121.39	(81)
Northwest	0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	60.68	(81)
Northwest	0.9x	0.77	x	4.37	x	72.63	x	0.55	x	0.8	=	96.78	(81)
Northwest	0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	42.13	(81)
Northwest	0.9x	0.77	x	4.37	x	50.42	x	0.55	x	0.8	=	67.19	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	23.45	(81)
Northwest	0.9x	0.77	x	4.37	x	28.07	x	0.55	x	0.8	=	37.4	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	11.86	(81)
Northwest	0.9x	0.77	x	4.37	x	14.2	x	0.55	x	0.8	=	18.92	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	7.7	(81)
Northwest	0.9x	0.77	x	4.37	x	9.21	x	0.55	x	0.8	=	12.28	(81)
Rooflights	0.9x	1	x	3.06	x	18.07	x	0.55	x	0.8	=	21.93	(82)
Rooflights	0.9x	1	x	3.06	x	37.96	x	0.55	x	0.8	=	46.06	(82)
Rooflights	0.9x	1	x	3.06	x	71.02	x	0.55	x	0.8	=	86.18	(82)
Rooflights	0.9x	1	x	3.06	x	119.98	x	0.55	x	0.8	=	145.58	(82)
Rooflights	0.9x	1	x	3.06	x	163.58	x	0.55	x	0.8	=	198.49	(82)
Rooflights	0.9x	1	x	3.06	x	175.24	x	0.55	x	0.8	=	212.64	(82)
Rooflights	0.9x	1	x	3.06	x	163.61	x	0.55	x	0.8	=	198.52	(82)
Rooflights	0.9x	1	x	3.06	x	129.11	x	0.55	x	0.8	=	156.67	(82)
Rooflights	0.9x	1	x	3.06	x	87.66	x	0.55	x	0.8	=	106.37	(82)
Rooflights	0.9x	1	x	3.06	x	47.1	x	0.55	x	0.8	=	57.15	(82)
Rooflights	0.9x	1	x	3.06	x	22.95	x	0.55	x	0.8	=	27.85	(82)
Rooflights	0.9x	1	x	3.06	x	14.62	x	0.55	x	0.8	=	17.74	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	161.34	292.69	447.93	634.57	783.39	809.67	767.32	651.4	511.8	336.28	196.5	135.97	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	585.3	714.6	856.49	1021.56	1148.47	1153.6	1097.49	987.48	858.93	705.2	590.46	548.72	(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

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(86)m=	0.99	0.99	0.96	0.86	0.69	0.49	0.36	0.42	0.68	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	20.07	20.39	20.74	20.93	20.99	21	21	20.95	20.65	20.19	19.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.94	19.95	19.95	19.96	19.96	19.97	19.97	19.97	19.97	19.96	19.96	19.95	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.83	0.63	0.42	0.28	0.32	0.6	0.9	0.98	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.75	19.2	19.68	19.9	19.97	19.97	19.97	19.94	19.59	18.92	18.39	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.21	19.61	20.04	20.26	20.32	20.33	20.33	20.29	19.96	19.36	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.93	19.21	19.61	20.04	20.26	20.32	20.33	20.33	20.29	19.96	19.36	18.88	(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	0.94	0.83	0.64	0.44	0.31	0.36	0.62	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	580.12	698.86	805.31	850.25	740.22	510.1	334.88	351.42	535.5	636.29	579.02	545.07	(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=	1358.42	1325.33	1211.56	1017.64	779.74	514.87	335.45	352.63	559.61	852.32	1122.31	1350.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	579.05	420.99	302.25	120.53	29.4	0	0	0	0	160.72	391.17	599.33	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2603.45 (98)

Space heating requirement in kWh/m²/year 32.83 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump	1	(303a)
Fraction of heat from Community heat pump (Water)	0.8	(303a)
Fraction of community heat from heat source 2 (Water)	0.2	(303b)
Fraction of total space heat from Community heat pump (302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system	1	(305)

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Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2603.45	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2733.62	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2104.32	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1767.63	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	441.91	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	27.34	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	22.1	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		241.75	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	241.75	(331)
Energy for lighting (calculated in Appendix L)		343.21	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2742.24	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	506.7	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	14.19	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	327.64	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	229.35	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.47	(372)

DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1089.34	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			1089.34	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	125.47	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	178.13	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			1093.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			13.79	(384)
EI rating (section 14)				88.21	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-102-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.44	(1a)	x	2.7	(2a)	=	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			0							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16553.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.82 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.76 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.15	47.01	46.86	46.15	46	45.29	45.29	45.15	45.58	46	46.29	46.58

Average = Sum(39)$_{1...12}$ /12= 46.11 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.9	0.9	0.91	0.92	0.92

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11

Total = Sum(44)$_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93

Total = Sum(45)$_{1...12}$ = 1174.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	
Output from water heater (annual)$_{1...12}$												1825.34	(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=	84.71	75.35	80.76	74.65	74.79	69.17	68.66	72.27	71.18	77.3	78.9	83.43	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)
Water heating gains (Table 5)													
(72)m=	113.86	112.13	108.55	103.68	100.52	96.07	92.29	97.14	98.86	103.9	109.59	112.14	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	324.09	322.41	312.75	297.28	281.86	266.76	256.8	261.6	269.41	285.04	302.99	316.19	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast	0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest 0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest 0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest 0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest 0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.12	418.12	462.49	514.32	553.7	549.28	523.92	485.89	442.15	395.89	366.61	359.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	0.99	0.99	0.97	0.89	0.73	0.52	0.38	0.43	0.68	0.93	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.2	20.33	20.55	20.81	20.95	20.99	21	21	20.98	20.78	20.45	20.18	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.15	20.16	20.17	20.17	20.17	20.16	20.16	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.86	0.68	0.46	0.31	0.35	0.61	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.08	19.27	19.58	19.94	20.12	20.17	20.17	20.17	20.15	19.92	19.46	19.05	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.66	(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	0.96	0.87	0.7	0.49	0.35	0.39	0.65	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.46	410.27	441.69	448.39	389.1	270.65	181.92	190.22	287.23	359.31	358.94	357.09	(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=	725.51	702.74	637.71	531.18	408.1	272.5	182.1	190.58	296.15	450.33	597.03	720.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	262.67	196.54	145.84	59.61	14.14	0	0	0	0	67.71	171.42	270.18	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1188.11 (98)

Space heating requirement in kWh/m²/year 23.55 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

DER WorkSheet: New dwelling design stage

Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)

Space heating — **kWh/year**

Annual space heating requirement		1188.11	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1247.51	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1825.34	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1533.28	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	383.32	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	12.48	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.17	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		157.84	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.84	(331)
Energy for lighting (calculated in Appendix L)		234.98	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		1063.99	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	231.23	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	6.47	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	284.21	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	198.94	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	9.95	(372)

DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	730.81	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			730.81	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	81.92	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	121.95	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			635.56	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.6	(384)
EI rating (section 14)				91.08	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Chris Hocknell **Stroma Number:** STRO016363
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Flat-201-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Total area of elements, m²			103.17							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(32a)
Party ceiling			71.04							(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) = 35.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 12.76 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.42 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	65.88	65.68	65.47	64.47	64.26	63.26	63.26	63.05	63.66	64.26	64.67	65.07	

Average = Sum(39)$_{1...12}$ /12= 64.42 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.92	0.92	0.91	0.9	0.89	0.89	0.89	0.9	0.9	0.91	0.92

Average = Sum(40)$_{1...12}$ /12= 0.91 (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 2.27 (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 88.14 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95	
										Total = Sum(44)$_{1...12}$ =			1057.67 (44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24	
										Total = Sum(45)$_{1...12}$ =			1386.77 (45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(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) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52

Output from water heater (annual)$_{1\ldots12}$ | 2037.61 | (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=	92.03	81.75	87.37	80.41	80.31	73.94	73.08	77.34	76.31	83.28	85.43	90.52	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)

Water heating gains (Table 5)

(72)m=	123.69	121.66	117.43	111.68	107.95	102.7	98.23	103.95	105.98	111.93	118.65	121.67	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	398.28	396.32	383.92	363.93	343.7	324.13	311.34	316.98	327.19	347.38	370.59	387.93	(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)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest 0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest 0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest 0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest 0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest 0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest 0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest 0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	497.43	576.58	660.73	757.48	830.68	827.88	788.57	721.41	643.94	554.74	491.43	471.45	(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	0.96	0.87	0.69	0.49	0.35	0.4	0.66	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.17	20.33	20.57	20.83	20.97	21	21	21	20.98	20.79	20.43	20.14	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.15	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.84	0.64	0.42	0.29	0.33	0.59	0.9	0.98	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.27	19.61	19.98	20.13	20.17	20.18	20.18	20.16	19.93	19.43	19	(90)

fLA = Living area ÷ (4) = | 0.39 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.47	19.68	19.98	20.31	20.46	20.49	20.49	20.5	20.48	20.26	19.81	19.44	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.47	19.68	19.98	20.31	20.46	20.49	20.49	20.5	20.48	20.26	19.81	19.44	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.85	0.66	0.45	0.31	0.36	0.62	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	493.59	566.06	627.34	641.02	544.77	371.21	246.18	257.93	396.79	500.92	482.58	468.7	(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=	999.52	970.62	882.77	735.55	562.63	372.67	246.3	258.21	405.83	620.8	822.23	991.82	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	376.41	271.86	190.04	68.06	13.29	0	0	0	0	89.19	244.55	389.2	

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Total per year (kWh/year) = Sum(98)1...5,9...12 =	1642.61	(98)
Space heating requirement in kWh/m²/year	23.12	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.			
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1642.61	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1724.74	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2037.61	
If DHW from community scheme:			
Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1711.59	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	427.9	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.25	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.39	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		222.31	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	222.31	(331)
Energy for lighting (calculated in Appendix L)		314.43	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		1685.13	(338)

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12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	319.69	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	8.95	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	317.26	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	222.08	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.1	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	879.08	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				879.08	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	115.38	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.19	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =				858.53	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.09	(384)
EI rating (section 14)					90.09	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-202-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		136.19	(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							0	x 10 =	0	(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) =	0 ÷ (5) =	0	(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		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.64 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.04	46.89	46.75	46.04	45.89	45.18	45.18	45.03	45.46	45.89	46.18	46.47	

Average = Sum(39)$_{1...12}$ /12= 46 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.92

Average = Sum(40)$_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11

Total = Sum(44)$_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93

Total = Sum(45)$_{1...12}$ = 1174.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2

Output from water heater (annual)$_{1...12}$ | 1825.34 | (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=	84.71	75.35	80.76	74.65	74.79	69.17	68.66	72.27	71.18	77.3	78.9	83.43	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.13	108.55	103.68	100.52	96.07	92.29	97.14	98.86	103.9	109.59	112.14	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.09	322.41	312.75	297.28	281.86	266.76	256.8	261.6	269.41	285.04	302.99	316.19	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast 0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.12	418.12	462.49	514.32	553.7	549.28	523.92	485.89	442.15	395.89	366.61	359.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	0.99	0.99	0.97	0.89	0.73	0.52	0.38	0.43	0.68	0.93	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.2	20.34	20.55	20.81	20.95	20.99	21	21	20.98	20.78	20.45	20.18	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.86	0.67	0.46	0.31	0.35	0.61	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.08	19.28	19.59	19.94	20.12	20.17	20.17	20.17	20.15	19.92	19.46	19.06	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.67	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.87	0.7	0.49	0.35	0.39	0.65	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.45	410.25	441.6	448.06	388.48	270.06	181.51	189.79	286.72	359.13	358.91	357.09	(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=	723.99	701.26	636.36	530.01	407.18	271.86	181.68	190.14	295.47	449.35	595.75	718.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	261.55	195.56	144.9	59	13.91	0	0	0	0	67.13	170.53	269.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1181.63 (98)

Space heating requirement in kWh/m²/year 23.43 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

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Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1181.63	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1240.71	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.34	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1533.28	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	383.32	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	12.41	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.17	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		157.84	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.84	(331)
Energy for lighting (calculated in Appendix L)		234.98	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		1057.19	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	229.98	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	6.44	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	284.21	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	198.94	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	9.95	(372)

DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	729.51	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			729.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	81.92	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	121.95	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			634.26	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.57	(384)
EI rating (section 14)				91.09	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-301-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.04	(1a)	x	2.7	(2a)	=	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Total area of elements, m²			103.17							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(32a)
Party ceiling			71.04							(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) = 35.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 23186.5 (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 12.73 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 48.39 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	65.85	65.65	65.45	64.44	64.24	63.23	63.23	63.03	63.63	64.24	64.64	65.04	

Average = $Sum(39)_{1...12}$ /12= 64.39 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.92	0.92	0.91	0.9	0.89	0.89	0.89	0.9	0.9	0.91	0.92	

Average = $Sum(40)_{1...12}$ /12= 0.91 (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 2.27 (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 88.14 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95

Total = $Sum(44)_{1...12}$ = 1057.67 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24

Total = $Sum(45)_{1...12}$ = 1386.77 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52

Output from water heater (annual)$_{1...12}$ — 2037.61 (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=	92.03	81.75	87.37	80.41	80.31	73.94	73.08	77.34	76.31	83.28	85.43	90.52	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)

Water heating gains (Table 5)

(72)m=	123.69	121.66	117.43	111.68	107.95	102.7	98.23	103.95	105.98	111.93	118.65	121.67	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	398.28	396.32	383.92	363.93	343.7	324.13	311.34	316.98	327.19	347.38	370.59	387.93	(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)

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Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest 0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest 0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest 0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest 0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest 0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest 0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest 0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	497.43	576.58	660.73	757.48	830.68	827.88	788.57	721.41	643.94	554.74	491.43	471.45	(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	0.96	0.87	0.69	0.49	0.35	0.4	0.66	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.17	20.33	20.57	20.83	20.97	21	21	21	20.98	20.79	20.43	20.14	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.15	20.15	20.16	20.16	20.18	20.18	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.84	0.64	0.42	0.29	0.33	0.59	0.9	0.98	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.27	19.62	19.98	20.13	20.17	20.18	20.18	20.16	19.93	19.43	19	(90)

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.47	19.68	19.98	20.31	20.46	20.49	20.49	20.5	20.48	20.26	19.82	19.44	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.47	19.68	19.98	20.31	20.46	20.49	20.49	20.5	20.48	20.26	19.82	19.44	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.85	0.66	0.45	0.31	0.36	0.62	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	493.59	566.06	627.32	640.93	544.61	371.07	246.09	257.83	396.66	500.87	482.57	468.69	(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=	999.17	970.28	882.46	735.27	562.42	372.52	246.21	258.11	405.67	620.58	821.93	991.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	376.15	271.64	189.83	67.93	13.25	0	0	0	0	89.06	244.34	388.94	

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	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1641.14	(98)
Space heating requirement in kWh/m²/year		23.1	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.			
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1641.14	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1723.2	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2037.61	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1711.59	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	427.9	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	17.23	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.39	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		222.31	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	222.31	(331)
Energy for lighting (calculated in Appendix L)		314.43	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		1683.59	(338)

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12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	319.41	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	8.94	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	317.26	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	222.08	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.1	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	878.79	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				878.79	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	115.38	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.19	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =				858.23	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.08	(384)
EI rating (section 14)					90.09	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-302-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.44	(1a)	x	2.7	(2a)	=	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Total area of elements, m²			78.29							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(32a)
Party ceiling			50.44							(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) = 23.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18066.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 10.71 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.64 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.04	46.89	46.75	46.04	45.89	45.18	45.18	45.03	45.46	45.89	46.18	46.47	

Average = $Sum(39)_{1...12}$ /12= 46 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.9	0.9	0.89	0.9	0.91	0.92	0.92	

Average = $Sum(40)_{1...12}$ /12= 0.91 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11	

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93	

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	

Output from water heater (annual)$_{1...12}$ | 1825.34 | (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=	84.71	75.35	80.76	74.65	74.79	69.17	68.66	72.27	71.18	77.3	78.9	83.43	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.13	108.55	103.68	100.52	96.07	92.29	97.14	98.86	103.9	109.59	112.14	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.09	322.41	312.75	297.28	281.86	266.76	256.8	261.6	269.41	285.04	302.99	316.19	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast	0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

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Northeast 0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast 0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast 0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast 0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast 0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast 0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast 0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast 0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast 0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast 0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast 0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast 0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast 0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast 0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast 0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast 0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast 0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast 0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast 0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast 0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast 0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast 0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest 0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest 0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest 0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest 0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest 0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest 0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest 0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest 0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest 0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest 0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest 0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest 0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.12	418.12	462.49	514.32	553.7	549.28	523.92	485.89	442.15	395.89	366.61	359.89	(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

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(86)m=	0.99	0.99	0.97	0.89	0.73	0.52	0.38	0.43	0.68	0.93	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.2	20.34	20.55	20.81	20.95	20.99	21	21	20.98	20.78	20.45	20.18	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.86	0.67	0.46	0.31	0.35	0.61	0.9	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.08	19.28	19.59	19.94	20.12	20.17	20.17	20.17	20.15	19.92	19.46	19.06	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.67	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.85	20.11	20.41	20.57	20.62	20.62	20.62	20.6	20.39	20	19.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.87	0.7	0.49	0.35	0.39	0.65	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.45	410.25	441.6	448.06	388.48	270.06	181.51	189.79	286.72	359.13	358.91	357.09	(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=	723.99	701.26	636.36	530.01	407.18	271.86	181.68	190.14	295.47	449.35	595.75	718.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	261.55	195.56	144.9	59	13.91	0	0	0	0	67.13	170.53	269.05	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1181.63 (98)

Space heating requirement in kWh/m²/year 23.43 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

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Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1181.63	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1240.71	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.34	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1533.28	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	383.32	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	12.41	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.17	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		157.84	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.84	(331)
Energy for lighting (calculated in Appendix L)		234.98	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		1057.19	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	229.98	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	6.44	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	284.21	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	198.94	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	9.95	(372)

DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	729.51	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			729.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	81.92	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	121.95	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			634.26	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.57	(384)
EI rating (section 14)				91.09	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-401-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.04	(1a) x	2.7	(2a) =	191.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.04	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.81	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			0.9	x1/[1/(1.4)+ 0.04]		=	1.19			(27)
Windows Type 3			5.79	x1/[1/(1.4)+ 0.04]		=	7.68			(27)
Windows Type 4			2.19	x1/[1/(1.4)+ 0.04]		=	2.9			(27)
Walls Type1	75.26	15.73	59.53	x	0.15	=	8.93			(29)
Walls Type2	27.91	1.99	25.92	x	0.15	=	3.89			(29)
Roof	75.26	0	75.26	x	0.13	=	9.78			(30)
Total area of elements, m²			178.43							(31)
Party wall			10.99	x	0	=	0			(32)
Party floor			71.04							(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) = 45.45 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 21732.64 (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 31.57 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 77.02 (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=	17.46	17.26	17.05	16.05	15.84	14.84	14.84	14.63	15.24	15.84	16.25	16.65	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	94.48	94.28	94.07	93.07	92.86	91.85	91.85	91.65	92.26	92.86	93.27	93.67	

Average = Sum(39)$_{1...12}$ /12= 93.01 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.33	1.32	1.31	1.31	1.29	1.29	1.29	1.3	1.31	1.31	1.32	

Average = Sum(40)$_{1...12}$ /12= 1.31 (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 2.27 (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 88.14 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	96.95	93.43	89.9	86.38	82.85	79.32	79.32	82.85	86.38	89.9	93.43	96.95

Total = Sum(44)$_{1...12}$ = 1057.67 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.78	125.75	129.76	113.13	108.55	93.67	86.8	99.6	100.79	117.47	128.22	139.24

Total = Sum(45)$_{1...12}$ = 1386.77 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.57	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.89	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52	(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=	199.05	175.68	185.04	166.62	163.83	147.16	142.08	154.88	154.29	172.74	181.72	194.52

Output from water heater (annual)$_{1...12}$ — 2037.61 (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=	92.03	81.75	87.37	80.41	80.31	73.94	73.08	77.34	76.31	83.28	85.43	90.52	(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=	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	113.56	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.8	15.81	12.86	9.74	7.28	6.14	6.64	8.63	11.58	14.71	17.17	18.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.71	201.78	196.56	185.44	171.41	158.22	149.41	147.34	152.56	163.68	177.71	190.9	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	-90.84	(71)
Water heating gains (Table 5)													
(72)m=	123.69	121.66	117.43	111.68	107.95	102.7	98.23	103.95	105.98	111.93	118.65	121.67	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	398.28	396.32	383.92	363.93	343.7	324.13	311.34	316.98	327.19	347.38	370.59	387.93	(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)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	0.9	x	11.28	x	0.55	x	0.8	=	3.1	(75)
Northeast 0.9x	0.77	x	0.9	x	22.97	x	0.55	x	0.8	=	6.3	(75)
Northeast 0.9x	0.77	x	0.9	x	41.38	x	0.55	x	0.8	=	11.36	(75)
Northeast 0.9x	0.77	x	0.9	x	67.96	x	0.55	x	0.8	=	18.65	(75)
Northeast 0.9x	0.77	x	0.9	x	91.35	x	0.55	x	0.8	=	25.07	(75)
Northeast 0.9x	0.77	x	0.9	x	97.38	x	0.55	x	0.8	=	26.73	(75)
Northeast 0.9x	0.77	x	0.9	x	91.1	x	0.55	x	0.8	=	25	(75)
Northeast 0.9x	0.77	x	0.9	x	72.63	x	0.55	x	0.8	=	19.93	(75)
Northeast 0.9x	0.77	x	0.9	x	50.42	x	0.55	x	0.8	=	13.84	(75)
Northeast 0.9x	0.77	x	0.9	x	28.07	x	0.55	x	0.8	=	7.7	(75)
Northeast 0.9x	0.77	x	0.9	x	14.2	x	0.55	x	0.8	=	3.9	(75)
Northeast 0.9x	0.77	x	0.9	x	9.21	x	0.55	x	0.8	=	2.53	(75)
Southeast 0.9x	0.77	x	5.79	x	36.79	x	0.55	x	0.8	=	64.96	(77)
Southeast 0.9x	0.77	x	5.79	x	62.67	x	0.55	x	0.8	=	110.65	(77)
Southeast 0.9x	0.77	x	5.79	x	85.75	x	0.55	x	0.8	=	151.4	(77)
Southeast 0.9x	0.77	x	5.79	x	106.25	x	0.55	x	0.8	=	187.59	(77)
Southeast 0.9x	0.77	x	5.79	x	119.01	x	0.55	x	0.8	=	210.11	(77)
Southeast 0.9x	0.77	x	5.79	x	118.15	x	0.55	x	0.8	=	208.59	(77)
Southeast 0.9x	0.77	x	5.79	x	113.91	x	0.55	x	0.8	=	201.11	(77)
Southeast 0.9x	0.77	x	5.79	x	104.39	x	0.55	x	0.8	=	184.3	(77)
Southeast 0.9x	0.77	x	5.79	x	92.85	x	0.55	x	0.8	=	163.93	(77)
Southeast 0.9x	0.77	x	5.79	x	69.27	x	0.55	x	0.8	=	122.29	(77)
Southeast 0.9x	0.77	x	5.79	x	44.07	x	0.55	x	0.8	=	77.81	(77)
Southeast 0.9x	0.77	x	5.79	x	31.49	x	0.55	x	0.8	=	55.59	(77)
Northwest 0.9x	0.77	x	1.37	x	11.28	x	0.55	x	0.8	=	23.57	(81)
Northwest 0.9x	0.77	x	2.19	x	11.28	x	0.55	x	0.8	=	7.53	(81)
Northwest 0.9x	0.77	x	1.37	x	22.97	x	0.55	x	0.8	=	47.97	(81)
Northwest 0.9x	0.77	x	2.19	x	22.97	x	0.55	x	0.8	=	15.34	(81)
Northwest 0.9x	0.77	x	1.37	x	41.38	x	0.55	x	0.8	=	86.43	(81)
Northwest 0.9x	0.77	x	2.19	x	41.38	x	0.55	x	0.8	=	27.63	(81)
Northwest 0.9x	0.77	x	1.37	x	67.96	x	0.55	x	0.8	=	141.94	(81)
Northwest 0.9x	0.77	x	2.19	x	67.96	x	0.55	x	0.8	=	45.38	(81)
Northwest 0.9x	0.77	x	1.37	x	91.35	x	0.55	x	0.8	=	190.79	(81)
Northwest 0.9x	0.77	x	2.19	x	91.35	x	0.55	x	0.8	=	61	(81)
Northwest 0.9x	0.77	x	1.37	x	97.38	x	0.55	x	0.8	=	203.41	(81)
Northwest 0.9x	0.77	x	2.19	x	97.38	x	0.55	x	0.8	=	65.03	(81)
Northwest 0.9x	0.77	x	1.37	x	91.1	x	0.55	x	0.8	=	190.28	(81)
Northwest 0.9x	0.77	x	2.19	x	91.1	x	0.55	x	0.8	=	60.84	(81)
Northwest 0.9x	0.77	x	1.37	x	72.63	x	0.55	x	0.8	=	151.7	(81)
Northwest 0.9x	0.77	x	2.19	x	72.63	x	0.55	x	0.8	=	48.5	(81)
Northwest 0.9x	0.77	x	1.37	x	50.42	x	0.55	x	0.8	=	105.31	(81)

Northwest	0.9x	0.77	x	2.19	x	50.42	x	0.55	x	0.8	=	33.67	(81)
Northwest	0.9x	0.77	x	1.37	x	28.07	x	0.55	x	0.8	=	58.62	(81)
Northwest	0.9x	0.77	x	2.19	x	28.07	x	0.55	x	0.8	=	18.74	(81)
Northwest	0.9x	0.77	x	1.37	x	14.2	x	0.55	x	0.8	=	29.65	(81)
Northwest	0.9x	0.77	x	2.19	x	14.2	x	0.55	x	0.8	=	9.48	(81)
Northwest	0.9x	0.77	x	1.37	x	9.21	x	0.55	x	0.8	=	19.25	(81)
Northwest	0.9x	0.77	x	2.19	x	9.21	x	0.55	x	0.8	=	6.15	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	99.16	180.26	276.81	393.55	486.97	503.76	477.22	404.43	316.75	207.36	120.84	83.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	497.43	576.58	660.73	757.48	830.68	827.88	788.57	721.41	643.94	554.74	491.43	471.45	(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	0.84	0.66	0.5	0.56	0.82	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.61	19.79	20.08	20.47	20.78	20.95	20.99	20.98	20.86	20.45	19.96	19.58	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.84	19.85	19.85	19.85	19.84	19.84	19.83	19.83	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.78	0.56	0.38	0.43	0.73	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=	18	18.25	18.68	19.23	19.63	19.81	19.84	19.84	19.73	19.21	18.51	17.96	(90)

fLA = Living area ÷ (4) = 0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.62	18.84	19.22	19.7	20.08	20.25	20.28	20.28	20.17	19.69	19.07	18.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.62	18.84	19.22	19.7	20.08	20.25	20.28	20.28	20.17	19.69	19.07	18.59	(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	0.42	0.48	0.76	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	493.87	568.49	639.42	692.13	657.54	494.4	334.41	348.52	488.42	523.39	484.65	468.76	(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=	1353.07	1314.67	1196.52	1005.55	777.75	519.04	338.46	355.69	559.69	843.84	1116.58	1347.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	639.24	501.43	414.48	225.67	89.44	0	0	0	0	238.41	454.99	653.86	

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	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3217.52	(98)
Space heating requirement in kWh/m²/year		45.29	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		3217.52	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	3378.4	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2037.61	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1711.59	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	427.9	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.78	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.39	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		222.31	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	222.31	(331)
Energy for lighting (calculated in Appendix L)		314.43	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3338.79	(338)

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12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	626.21	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	17.53	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	317.26	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	222.08	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.1	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1194.18	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1194.18	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	115.38	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	163.19	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =				1173.63	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.52	(384)
EI rating (section 14)					86.45	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.51

Property Address: Flat-402-GREEN

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.44	(1a) x	2.7	(2a) =	136.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.44	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.19	(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							0	x 10 =	0	(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) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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			1.99	x	1	=	1.99			(26)
Windows Type 1			1.37	x1/[1/(1.4)+ 0.04]		=	1.82			(27)
Windows Type 2			4.65	x1/[1/(1.4)+ 0.04]		=	6.16			(27)
Windows Type 3			1.54	x1/[1/(1.4)+ 0.04]		=	2.04			(27)
Walls Type1	55.8	8.93	46.87	x	0.15	=	7.03			(29)
Walls Type2	22.49	1.99	20.5	x	0.15	=	3.08			(29)
Roof	50.44	0	50.44	x	0.13	=	6.56			(30)
Total area of elements, m²			128.73							(31)
Party wall			9.64	x	0	=	0			(32)
Party floor			50.44							(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) = 30.49 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17007.06 (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 24.32 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 54.81 (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=	12.4	12.25	12.11	11.39	11.25	10.53	10.53	10.39	10.82	11.25	11.54	11.82	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	67.21	67.06	66.92	66.2	66.06	65.34	65.34	65.2	65.63	66.06	66.35	66.63	

Average = $Sum(39)_{1...12}$ /12= 66.17 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.33	1.33	1.33	1.31	1.31	1.3	1.3	1.29	1.3	1.31	1.32	1.32

Average = $Sum(40)_{1...12}$ /12= 1.31 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.65 (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=	82.11	79.13	76.14	73.15	70.17	67.18	67.18	70.17	73.15	76.14	79.13	82.11

Total = $Sum(44)_{1...12}$ = 895.77 (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=	121.77	106.5	109.9	95.81	91.94	79.33	73.51	84.36	85.37	99.49	108.6	117.93

Total = $Sum(45)_{1...12}$ = 1174.5 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.27	15.98	16.48	14.37	13.79	11.9	11.03	12.65	12.8	14.92	16.29	17.69	(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) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	(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=	177.05	156.43	165.18	149.31	147.21	132.83	128.79	139.63	138.86	154.76	162.09	173.2	

Output from water heater (annual)$_{1...12}$ | 1825.34 | (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=	84.71	75.35	80.76	74.65	74.79	69.17	68.66	72.27	71.18	77.3	78.9	83.43	(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=	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	85.15	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.31	11.82	9.61	7.28	5.44	4.59	4.96	6.45	8.66	10.99	12.83	13.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.38	149.92	146.04	137.78	127.35	117.55	111	109.46	113.34	121.6	132.03	141.83	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	31.52	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	-68.12	(71)

Water heating gains (Table 5)

(72)m=	113.86	112.13	108.55	103.68	100.52	96.07	92.29	97.14	98.86	103.9	109.59	112.14	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.09	322.41	312.75	297.28	281.86	266.76	256.8	261.6	269.41	285.04	302.99	316.19	(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	4.65	x	11.28	x	0.55	x	0.8	=	16	(75)
Northeast	0.9x	0.77	x	1.54	x	11.28	x	0.55	x	0.8	=	5.3	(75)

Northeast	0.9x	0.77	x	4.65	x	22.97	x	0.55	x	0.8	=	32.56	(75)
Northeast	0.9x	0.77	x	1.54	x	22.97	x	0.55	x	0.8	=	10.78	(75)
Northeast	0.9x	0.77	x	4.65	x	41.38	x	0.55	x	0.8	=	58.67	(75)
Northeast	0.9x	0.77	x	1.54	x	41.38	x	0.55	x	0.8	=	19.43	(75)
Northeast	0.9x	0.77	x	4.65	x	67.96	x	0.55	x	0.8	=	96.35	(75)
Northeast	0.9x	0.77	x	1.54	x	67.96	x	0.55	x	0.8	=	31.91	(75)
Northeast	0.9x	0.77	x	4.65	x	91.35	x	0.55	x	0.8	=	129.52	(75)
Northeast	0.9x	0.77	x	1.54	x	91.35	x	0.55	x	0.8	=	42.89	(75)
Northeast	0.9x	0.77	x	4.65	x	97.38	x	0.55	x	0.8	=	138.08	(75)
Northeast	0.9x	0.77	x	1.54	x	97.38	x	0.55	x	0.8	=	45.73	(75)
Northeast	0.9x	0.77	x	4.65	x	91.1	x	0.55	x	0.8	=	129.17	(75)
Northeast	0.9x	0.77	x	1.54	x	91.1	x	0.55	x	0.8	=	42.78	(75)
Northeast	0.9x	0.77	x	4.65	x	72.63	x	0.55	x	0.8	=	102.98	(75)
Northeast	0.9x	0.77	x	1.54	x	72.63	x	0.55	x	0.8	=	34.1	(75)
Northeast	0.9x	0.77	x	4.65	x	50.42	x	0.55	x	0.8	=	71.49	(75)
Northeast	0.9x	0.77	x	1.54	x	50.42	x	0.55	x	0.8	=	23.68	(75)
Northeast	0.9x	0.77	x	4.65	x	28.07	x	0.55	x	0.8	=	39.8	(75)
Northeast	0.9x	0.77	x	1.54	x	28.07	x	0.55	x	0.8	=	13.18	(75)
Northeast	0.9x	0.77	x	4.65	x	14.2	x	0.55	x	0.8	=	20.13	(75)
Northeast	0.9x	0.77	x	1.54	x	14.2	x	0.55	x	0.8	=	6.67	(75)
Northeast	0.9x	0.77	x	4.65	x	9.21	x	0.55	x	0.8	=	13.06	(75)
Northeast	0.9x	0.77	x	1.54	x	9.21	x	0.55	x	0.8	=	4.33	(75)
Southwest	0.9x	0.77	x	1.37	x	36.79		0.55	x	0.8	=	30.74	(79)
Southwest	0.9x	0.77	x	1.37	x	62.67		0.55	x	0.8	=	52.36	(79)
Southwest	0.9x	0.77	x	1.37	x	85.75		0.55	x	0.8	=	71.64	(79)
Southwest	0.9x	0.77	x	1.37	x	106.25		0.55	x	0.8	=	88.77	(79)
Southwest	0.9x	0.77	x	1.37	x	119.01		0.55	x	0.8	=	99.43	(79)
Southwest	0.9x	0.77	x	1.37	x	118.15		0.55	x	0.8	=	98.71	(79)
Southwest	0.9x	0.77	x	1.37	x	113.91		0.55	x	0.8	=	95.17	(79)
Southwest	0.9x	0.77	x	1.37	x	104.39		0.55	x	0.8	=	87.22	(79)
Southwest	0.9x	0.77	x	1.37	x	92.85		0.55	x	0.8	=	77.58	(79)
Southwest	0.9x	0.77	x	1.37	x	69.27		0.55	x	0.8	=	57.87	(79)
Southwest	0.9x	0.77	x	1.37	x	44.07		0.55	x	0.8	=	36.82	(79)
Southwest	0.9x	0.77	x	1.37	x	31.49		0.55	x	0.8	=	26.31	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.04	95.71	149.75	217.03	271.84	282.52	267.12	224.3	172.74	110.85	63.62	43.7	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	376.12	418.12	462.49	514.32	553.7	549.28	523.92	485.89	442.15	395.89	366.61	359.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	0.99	0.99	0.98	0.95	0.86	0.69	0.53	0.59	0.83	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.65	19.8	20.07	20.43	20.75	20.93	20.98	20.98	20.84	20.45	19.99	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.82	19.82	19.82	19.83	19.83	19.84	19.84	19.85	19.84	19.83	19.83	19.82	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.93	0.81	0.59	0.4	0.46	0.75	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=	18.05	18.27	18.66	19.18	19.59	19.8	19.84	19.84	19.72	19.21	18.55	18.02	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.1	19.42	19.86	20.22	20.42	20.46	20.46	20.33	19.88	19.33	18.89	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.1	19.42	19.86	20.22	20.42	20.46	20.46	20.33	19.88	19.33	18.89	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.83	0.65	0.47	0.53	0.79	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.95	412.2	449.11	477.26	457.39	355.18	247.65	256.79	347.83	374.72	361	357.37	(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=	982.63	952.37	864.84	725.6	562.97	380.13	252.36	264.48	408.95	613.2	811.65	979	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	453.6	363	309.31	178.81	78.55	0	0	0	0	177.43	324.46	462.49	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2347.64 (98)

Space heating requirement in kWh/m²/year 46.54 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.8	(303a)
Fraction of community heat from heat source 2 (Water)		0.2	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2347.64	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2465.03	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1825.34	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1533.28	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	383.32	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	24.65	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.17	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		157.84	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.84	(331)
Energy for lighting (calculated in Appendix L)		234.98	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-576.34	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2281.5	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	456.91	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	12.79	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	284.21	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	198.94	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	9.95	(372)

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Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	962.8	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			962.8	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	81.92	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	121.95	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-299.12	(380)
Total CO2, kg/year	sum of (376)…(382) =			867.55	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.2	(384)
EI rating (section 14)				87.82	(385)