RIBA Stage 2
Energy Assessment
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Disclaimer

Contents:

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About the Scheme

The proposed scheme involves the change of use of an existing building with an extension of a basement and a new level on top. The redevelopment comprises 8 residential units and 3 level of office spaces over the 6-storey building. The refurbishment works for part of the ground floor to the 2nd levels provide 7 residential units and the new extension to the 3rd level provides 1 additional residential unit. The refurbished part ground and lower ground level provides approx. 580m^2 of office space and the new addition of the basement accommodates extra 339m^2 of office space.

Planning policy

The scheme has been developed in accordance with the Intend to Publish London Plan 2019 and with the Sustainable, Design and Construction SPG. According to the planning policies, the scheme should achieve:

- Zero carbon target
- A minimum on-site CO_2 reduction of at least 35% beyond Building Regulations
- Residential development should achieve 10% CO_2 improvement through energy efficiency measures, 'Be Lean' stage
- Non-domestic development should achieve 15% CO_2 improvement through energy efficiency measures 'Be Lean' 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:
    1. through a cash in lieu contribution to the borough's carbon offset fund, or
    2. off-site provided that an alternative proposal is identified, and delivery is certain

Summary

All the residential units and the non-domestic unit have been analysed.

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 L2A (office) – The actual building CO_2 emissions rate (BER) is no greater than the notional building CO2 target emissions rate.
- New build, Part L1A (Flat 6,7 and 8) – The actual dwelling CO_2 emissions rate (DER) is no greater than the notional CO2 target emissions rate.
- Refurbishment, Part L1B (Flat 1 to 5) – 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 CO_2 emissions of the scheme have been calculated using the SAP 10.0 carbon emission factors, and the scheme can achieve:

- An on-site CO_2 reduction of 52.5% beyond Building Regulations through energy efficiency measures and maximised of renewable technologies (Air Source Heat Pumps)
- Residential part of the development achieves 28.3% CO_2 improvement through energy efficiency measures, 'Be Lean' stage
- Non-domestic part of the development achieves 9.1% CO_2 improvement through energy efficiency measures, 'Be Lean' stage. The development is unable to achieve the 15% improvement due to high hot water demand which is 54.5% of the whole energy demand.
- A further improvement of 35.3% CO_2 has been achieved through renewable technologies 'Be Green' stage (Air Source Heat Pumps)
- Overall, the scheme achieves an improvement of 52.5% 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 £55,026

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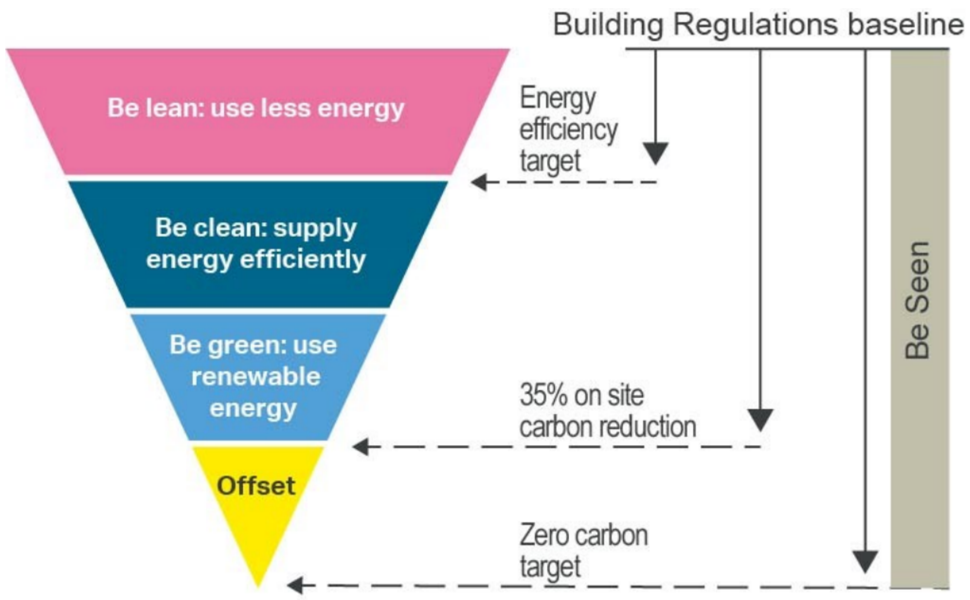
Energy hierarchy

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 and sensors
    - Mechanical ventilation with heat recovery
- Be Green:
    - Communal Air Source Heat Pumps to provide space heating and hot water

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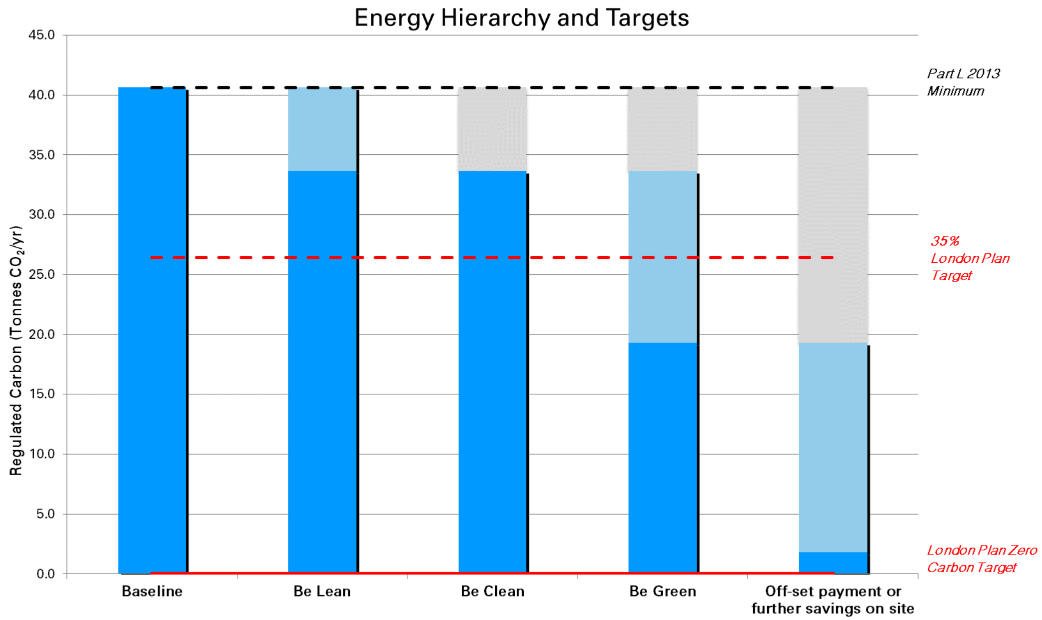
GLA's Energy Hierarchy: Regulated carbon emissions

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 17.2% from the fabric energy efficiency measures described in the 'Be Lean' section and will reduce total carbon emissions by 52.5% 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).

Therefore, the scheme meets and exceeds the planning policy carbon reduction target and complies with London Plan Policy 5.2 and Intend to Publish London Plan 2019 Policy SI2.

The carbon offset payment to meet the zero-carbon target has been calculated as £55,026



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Regulated CO_2 emissions – Site-wide

Site-wide				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 2012 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	53.68	44.82	–	43.01
CO_2 emissions saving (tCO_2/yr)	–	8.86	–	1.81
Saving from each stage (%)	–	16.5	–	3.4
Total CO_2 emissions saving (tCO_2/yr)	10.67			
19.9% total CO_2 savings over notional specification for existing buildingsand 2013 Building Regulations Part L achieved				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 10.0 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	40.65	33.67	–	19.31
CO_2 emissions saving (tCO_2/yr)	–	6.98	–	14.36
Saving from each stage (%)	–	17.2	–	35.3
Total CO_2 emissions saving (tCO_2/yr)	21.34			
52.5% total CO_2 savings over notional specification for existing buildingsand 2013 Building Regulations Part L achieved				

Regulated CO_2 emissions – Non-domestic

Non-domestic				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 2012 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	35.00	31.12	–	30.72
CO_2 emissions saving (tCO_2/yr)	–	3.87	–	0.40
Saving from each stage (%)	–	11.11	–	1.2
Total CO_2 emissions saving (tCO_2/yr)	4.28			
12.2% total CO_2 savings over 2013 Building Regulations Part L achieved				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 10.0 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	23.56	21.42	–	13.79
CO_2 emissions saving (tCO_2/yr)	–	2.14	–	7.63
Saving from each stage (%)	–	9.1	–	32.4
Total CO_2 emissions saving (tCO_2/yr)	9.77			
41.5% total CO_2 savings over 2013 Building Regulations Part L achieved				

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Regulated CO_2 emissions – Domestic new built

Domestic new built				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 2012 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	4.57	4.44	–	4.09
CO_2 emissions saving (tCO_2/yr)	–	0.13	–	0.35
Saving from each stage (%)	–	2.9	–	7.6
Total CO_2 emissions saving (tCO_2/yr)	0.48			
10.6% total CO_2 savings over 2013 Building Regulations Part L achieved				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 10.0 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	4.09	3.83	–	1.84
CO_2 emissions saving (tCO_2/yr)	–	0.26	–	2.00
Saving from each stage (%)	–	6.4	–	48.7
Total CO_2 emissions saving (tCO_2/yr)	2.26			
55.1% total CO_2 savings over 2013 Building Regulations Part L achieved				

Regulated CO_2 emissions – Domestic refurbishment

Domestic refurbishment				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 2012 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	14.11	9.26	–	8.20
CO_2 emissions saving (tCO_2/yr)	–	4.85	–	1.06
Saving from each stage (%)	–	34.4	–	7.5
Total CO_2 emissions saving (tCO_2/yr)	5.91			
41.9% total CO_2 savings over notional specification for existing buildingsachieved				
GLA's Energy Hierarchy: Regulated CO_2 – Calculated using SAP 10.0 CO_2 factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO_2 emissions (tCO_2/yr)	12.99	8.41	–	3.68
CO_2 emissions saving (tCO_2/yr)	–	4.58	–	4.73
Saving from each stage (%)	–	35.2	–	36.4
Total CO_2 emissions saving (tCO_2/yr)	9.31			
71.7% total CO_2 savings over notional specification for existing buildings achieved				

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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 CO_2/kWh)	
	SAP 2012	SAP10.0
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

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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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 Intend to Publish London Plan 2019.

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

- Baseline: A calculation of the Part L 2013 Building Regulations compliant CO_2 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 Policy 5.9 of London Plan and Intent to Publish London Plan 2019 Policy 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 Policy 5.6 of London Plan and Intent to Publish London Plan 2019 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 Policy 5.7 of London Plan and Intent to Publish London Plan 2019 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.

Establishing CO_2
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Establishing CO_2 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.

CO_2 Emissions – Regulated and Unregulated (tonnes CO_2/yr) – SAP 10.0 – Site-wide			
	Regulated Emissions	Unregulated Emissions	Total Emissions
Baseline: Part L 2013	40.65	15.97	56.62
Be Lean: Use less energy	33.67	15.97	49.64
Be Clean: Supply energy efficiently	–	–	–
Be Green: Use renewable energy	19.31	15.97	35.28
CO_2 Emissions – Regulated and Unregulated (tonnes CO_2/yr) – SAP 10.0 – Non-domestic			
	Regulated Emissions	Unregulated Emissions	Total Emissions
Baseline: Part L 2013	23.56	10.46	34.02
Be Lean: Use less energy	21.42	10.46	31.88
Be Clean: Supply energy efficiently	–	–	–
Be Green: Use renewable energy	13.79	10.46	24.25
CO_2 Emissions – Regulated and Unregulated (tonnes CO_2/yr) – SAP 10.0 – Domestic			
	Regulated Emissions	Unregulated Emissions	Total Emissions
Baseline: Part L 2013	17.09	5.52	22.60
Be Lean: Use less energy	12.25	5.52	17.76
Be Clean: Supply energy efficiently	–	–	–
Be Green: Use renewable energy	5.52	5.52	11.03

Carbon offsetting

London Plan's Policy 5.2 and Intend to Publish London Plan 2019 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. The table below confirms the cash-in-lieu contribution for both domestic and non-domestic units.

Regulated carbon dioxide savings from each stage of the energy hierarchy – SAP 10.0		
	(tonnes CO_2/yr)	%
Be Lean: Savings from energy demand reduction	6.98	17.2%
Be Clean: Savings from heat networks	0.00	0.0%
Be Green: Savings from renewable energy	14.36	35.3%
Cumulative on-site savings	21.34	52.5%
Carbon shortfall	19.31	–
	(tonnes CO_2)	
Cumulative savings for offset	579.22	
Cash-in-lieu contribution	£55,026	

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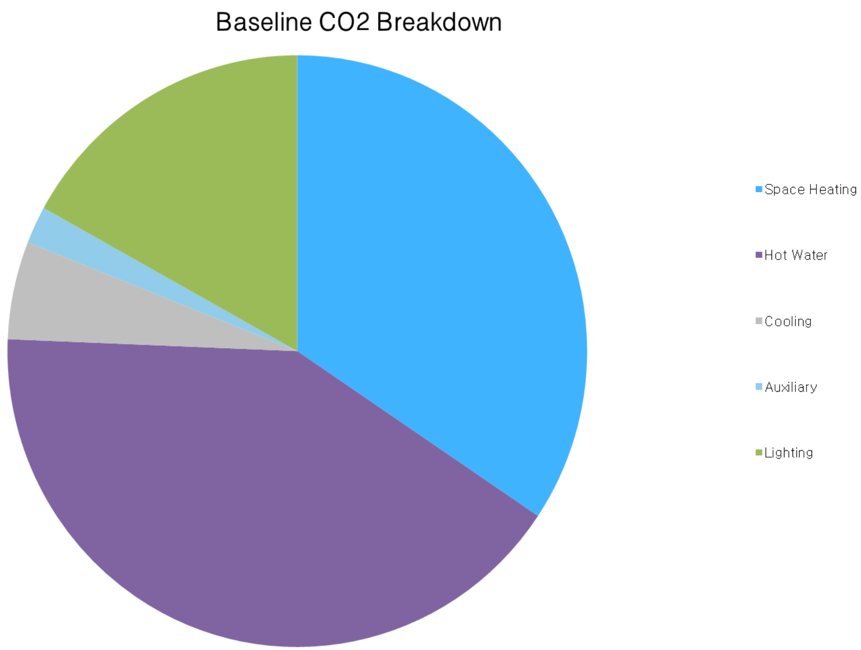
Building regulations Part L 2013 minimum compliance

The total baseline carbon emissions for the whole scheme is 40.65 tonnes CO_2/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 hot water is the primary source of carbon dioxide emissions, and space heating is the second largest, across the scheme as a whole. The carbon emissions from the domestic part of the scheme are mostly from space heating, whereas the carbon emissions from the non-domestic part of the scheme are from hot water.

Carbon Emissions in tonnes CO_2/yr.				
Heating	Hot Water	Cooling	Auxiliary	Lighting
13.99	16.76	2.18	0.83	6.89



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Be Lean: summary

Demand reduction measures have reduced the scheme's carbon emissions by 17.2% (using SAP 10.0 figures) over the minimum Part L 2013 Building Regulations baseline and notional specification for existing buildings (Appendix 4 of GLA's Guidance).

U-values

Non- Domestic		
Element	Minimum Building Regulations U-value W/m^{2}K	Proposed U-value W/m^{2}K
Flat roof	0.25	0.12
Wall – Lower ground floor and ground floor	0.35	0.23
Wall – Basement	0.35	0.12
Ground floor	0.25	0.12
Exposed floor	0.25	0.12
Windows – Lower ground floor and ground floor	2.20	1.6 (g-value 0.50)
Windows – Basement	2.20	1.2 (g-value 0.27)
Doors	2.20	1.4

Domestic			
Element	Minimum Building Regulations U-value W/m^{2}K	Existing Building U-value W/m^{2}K Appendix 4 (GLA guidance 2020)	Proposed U-value W/m^{2}K
Flat roof	0.20	0.18	0.12
Pitched roof	0.20	0.18	0.12
Wall – Existing	–	0.55	0.23
Wall – New	0.30	–	0.12
Corridor wall	0.30	–	0.12
Ground floor	0.25	0.55	0.12
Exposed floor	0.25	0.55	0.12
Windows – Existing	2.00	1.60 (g-value 0.63)	1.6 (g-value 0.63)
Windows – New	2.00	1.60 (g-value 0.63)	1.2 (g-value 0.50)
Rooflights	2.00	1.60 (g-value 0.63)	1.2 (g-value 0.50)
Doors	2.00	1.60	1.4

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

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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
Non-domestic	10	10	5
Domestic – Existing (Flat 1 to 5)	10	10	5
Domestic – New (Flat 6, 7 and 8)	10	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 default psi-value has been used for all junctions.

Thermal Mass:

Thermal mass of the scheme has been indicatively modelled as 250 kJ/m^{2}K (medium).

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Heating

Domestic: 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 2.90 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.

Non-domestic: For the 'Be Lean' scenario, the scheme has been modelled with a gas boiler with an efficiency of 91% (as required by the GLA). For the 'Be Green' final scenario, a communal air source heat pump with a minimum COP of 2.90 will be proposed as the main heating system. Heat will be provided via radiators and will be controlled by local time and temperature.

Hot Water

Domestic: 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 communal air source heat pump, with a minimum COP of 2.90. A top-up electric immersion heater will provide less than 20% of the hot water demand.

Non-domestic: For the 'Be Lean', the hot water will be provided by the main gas heating system (gas boilers with an efficiency of 91%). For the 'Be Green' final scenario, hot water will be provided by the air source heat pump, with a minimum COP of 2.90. A top-up electric immersion heater will provide less than 20% of the hot water demand.

Ventilation

Domestic: Balanced ventilation with heat recovery has been specified for the new apartments (flat 6, 7 and 8).

- The apartments with one wet room have been modelled with an SFP of 0.58 W/l/s and a heat recovery efficiency of 90%.
- The apartments with three wet rooms have been modelled with an SFP of 0.71 W/l/s and a heat recovery efficiency of 86%.

Natural ventilation with extract fans fr the bathrooms has been specified for the existing flats (1 to 5).

Non-domestic: Mechanical ventilation with heat recovery and demand control ventilation (dependent on occupancy and speed control) has been specified for the offices and meeting rooms of the commercial area, with a minimum heat recovery efficiency of 85% and an SFP of 1.4W/(l/s). Extract ventilation has been specified for the toilets with a flow rate less than 5l/s/m^2 and an SFP less than 0.3W/l/s.

Cooling

Domestic: No cooling has been specified for the apartments.

Non-domestic: Cooling will be provided by an air source heat pump with EER of 3.8 and a SEER of 4.2.

Lighting

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

Non-domestic: High efficiency lighting has been specified for the commercial area with a minimum efficacy of 120lumens/W. PIR sensors have been specified for all areas with a parasitic power of less than 0.1W/m^2. Photoelectric controlled daylight dimming sensors have been specified for the offices with a parasitic power of less than 0.1W/m^2.

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Energy demand following energy efficiency measures (MWh/year)

	Space Heating	Hot water	Lighting	Auxiliary	Cooling	Unregulated gas	Unregulated electricity
Domestic	35.2	18.8	3.1	0.9	0.0	0.0	12.3
Non-domestic	4.8	61.1	15.0	4.8	12.8	0.0	44.9

Fabric energy efficiency

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
Domestic – New	13.56	12.61	7%
Domestic – Existing	43.79	25.51	42%
Domestic	57.35	38.12	34%

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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.
    - Light-coloured 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.
    - High albedo materials: A high albedo (reflective) surface has been specified for the roof and vertical facades in order to minimise the heat absorbed by the roof, and significant thermal insulation has been specified to prevent any heat absorbed being transferred into the building.
    - 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 and dense masonry external walls. 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 where possible 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 offices to make use of 'free cooling' where the outside air temperature is below that in the building during summer months.
    - A mixed mode system will be implemented. This will be complimentary to the passive cooling measures taken. During summer months, mechanical ventilation using fans will remove hot air from the building. The building will also adopt a zoned design to allow natural ventilation where possible and mechanical ventilation where there are increased cooling loads such as server/IT rooms and equipment and high-density offices.
    - The mechanical systems will comply with the Domestic and Non-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
Flat 1	Slight
Flat 2	Not significant
Flat 3	Not significant
Flat 4	Not significant
Flat 5	Not significant
Flat 6	Medium
Flat 7	Medium
Flat 8	Slight
Offices – Basement	Not significant
Offices – Lower Ground	Not significant
Offices – Ground	Not significant

According to the GLA guidance on preparing energy assessments (April 2020) Section 8, a dynamic modelling in line with CIBSE TM52 and TM59 should be carried out to assess the risk of overheating. However, the risk of overheating from the SAP and SBEM model indicates no significant to medium risk, therefore an overheating analysis has not been undertaken.

Active cooling

Air conditioning has not been specified for the domestic part of the scheme, since the overheating analysis demonstrates the there is no significant risk of overheating and the passive design measured are enough to guarantee the occupant's comfort.

In the non-domestic unit, the actual cooling demand is above that of the notional, as it is shown in the table below. According to the latest GLA guidance, the cooling demand should be lower than the notional building. The proposed unit consists of existing solid brick façade (that will be internally insulated) and existing windows. The design team has considered all available measures to reduce internal heat gains and solar heat gains on the new windows of the basement). However, a high g-value of 0.5 needs to be specified for the existing windows (lower ground floor and ground floor) to match the appearance and character of the existing building. Therefore, the scheme results in a higher cooling demand compared to the notional building.

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	111.6	137680
Notional	98.1	121025

To ensure the cooling system is the most carbon efficient possible the following parameters have been selected:

- Location: Indoor cooling units have been specified on a localised basis where internal gains are too high. The units will be fully fitted with local temperature controls for optimal usage.
- The location of the outdoor units that 'dump' the heat has been carefully conspired carefully so not to cause problems for people and the environment, and not to add to the urban heat island effect. They will be located on the roof space and will allow adequate air movement around the condensing units; this will ensure maximum operating efficiency and will limit the impacts of dumped heat on people and the environment.
- The AC systems will have the following efficiencies which are in compliance with the Non-Domestic Building Services Compliance Guide:
    - Seasonal Energy Efficiency Ratio of 4.2
    - Energy Efficiency Ratio of 3.8

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 5.6B of London Plan and Policy SI3 of Intended to publish London Plan. 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 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:

a) connect to local existing or planned heat networks
b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) 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)
d) use ultra-low NOx gas boilers

(CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of London Plan Policy SI 1 Improving air quality)

Connect to local existing or planned heat network

The illustration below shows the London heat map. Red lines are existing heat networks and orange lines are proposed heat networks. 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 Intend to Publish London Plan 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. The possibilities of capturing waste heat from nearby sources has been undertaken, however the amount of heat available is likely a fraction of the scheme's demand which makes its collection trivial within the context of 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 administrative burden of managing CHP electricity sales at a small scale without an active energy service companies (ESCOs) is prohibitive for smaller operators of residential developments.

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 demonstrate 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).

Air quality impacts

An air quality assessment is required for all major developments as per the Intend to Publish London Plan 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 Feasibility:

In line with Policy SI2 of the Intend to publish London Plan 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 is 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 CO_2 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 £30,000. 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)	CO_2 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) – Rejected

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 development will not have solar PVs installed, as there is limited roof space with the ASHP taking up majority of the available space.

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, visual impact, 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 CO_2 emissions reduction that would be produced by solar hot water as a standalone system would not be adequate to achieve the required CO_2 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, use of unutilised roof space, no noise issues, visual impact, 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 (GSHP) –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	Rejected – High air quality impact	✓	✓✓✓	✓✓✓✓✓	9
Photovoltaic	Accepted – High CO_2 savings and have low visual impact	✓✓	✓✓	✓✓✓✓✓ ✓✓✓	12
Solar Thermal	Rejected – Low CO_2 savings compared to PV panels	✓✓	✓✓✓	✓✓✓✓✓ ✓	11
Wind Energy	Rejected – High visual and noise impact	✓	✓✓✓✓	✓✓✓✓✓	10
GSHP	Rejected – High capital cost	✓✓	✓	✓✓✓✓✓ ✓✓✓	11
ASHP	Accepted – Can provide carbon savings with minimal site impact	✓✓✓✓	✓✓	✓✓✓✓✓ ✓✓	13

ASHPs have scored the best. Due to the limited roof space, ASHPs have been specified as they can provide higher CO_2 savings compared to the PV and 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 2.9 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 (£)	35,000	95,000
Maintenance and replacement cost (£)	40,000	10,000
Total (£)	75,000	105,000
Energy demand (kWh)	119,876	46,119
Cost of gas/electricity (p/kWh)	5	12.5
Annual operational cost (£)	5,994	5,765

It should be noted that the figures above are based on SAP and SBEM modelling for CO_2 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 (£)	30,000
Predicted Annual Savings (£)	229
Payback Period (years)	131.0
Energy and Carbon Performance Criteria	Value
Predicted Annual Energy Saved (kWh/yr)	73,757
Annual Carbon Emissions Reductions (kg CO_2/year) using SAP10.0 carbon factors	14,362
CO_2 Emissions Reduction (%) with SAP10.0	35.3%

End-users will be supplied with regular information to control and operate the system and maintenance visits. The performance of the system will be monitored postconstruction to ensure it is achieving the expected performance approved during planning, in line with the 'Be Seen policy.

Peak Energy Demand
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Flexibility and peak energy demand

The scheme is required to minimise both annual and peak energy demand as it is required by Intend to Publish London Plan Policy SI2 and SI3.

Flexibility potential and revised peak demand

The scheme will reduce the peak demand by incorporate the following measures:

Flexibility achieved through:	Yes/No	Details
Electrical energy storage (kWh) capacity	No	–
Heat energy storage (kWh) capacity	Yes	Thermal store of 2000l
Renewable energy generation (load matching)	No	–
Gateway to enable automated demand response	No	–
Smart systems integration (e.g. smart charge points for EV, gateway etc.)	No	–
Other initiative	No	–

Cost to Occupants
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Controls

The proposed scheme sets out to address demand side response to energy efficiency, including smart meters, to provide more consumption data to inform control which will allow the running of some equipment at a lower capacity during times of peak demand. The design team will also explore the possibility of energy storage, smart controls, to optimise heating and power systems at a later stage of the project.

Running costs

Maximum operational energy expenses come from heating and hot water. The domestic and non-domestic units are being serviced by a system breakup of 80% demand being met by air source heat pumps and 20% from electric immersion heater.

The scheme wide demand figures below have been derived from SAP DER worksheets.

Electricity demand	kWh/year
Heating and hot water	19,969
Lighting	3.801
Ventilation	623
Unregulated	23,671
Fuel	Price
Electricity	12.5p/kWh

Average cost per apartment	Cost/apartment/year
Electricity	£739

Conclusion
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Summary

All the residential units and the non-domestic unit have been analysed.

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 L2A (office) – The actual building CO_2 emissions rate (BER) is no greater than the notional building CO2 target emissions rate.
- New build, Part L1A (Flat 6,7 and 8) – The actual dwelling CO_2 emissions rate (DER) is no greater than the notional CO2 target emissions rate.
- Refurbishment, Part L1B (Flat 1 to 5) – 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 CO_2 emissions of the scheme have been calculated using the SAP 10.0 carbon emission factors, and the scheme can achieve:

- An on-site CO_2 reduction of 52.5% beyond Building Regulations through energy efficiency measures and maximised of renewable technologies (Air Source Heat Pumps)
- Residential part of the development achieves 28.3% CO_2 improvement through energy efficiency measures, 'Be Lean' stage
- Non-domestic part of the development achieves 9.1% CO_2 improvement through energy efficiency measures, 'Be Lean' stage. The development is unable to achieve the 15% improvement due to high hot water demand which is 54.5% of the whole energy demand.
- A further improvement of 35.3% CO_2 has been achieved through renewable technologies 'Be Green' stage (Air Source Heat Pumps)
- Overall, the scheme achieves an improvement of 52.5% 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 £55,026

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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)	Total fuel consumption (non– residential) (MWh/year)
Grid electricity	47.3	104,1
Gas boilers (communal/individual)	–	–
Gas CHP	–	–
Connection to existing District Heating network	–	–
Other gas use (e.g. cookers)	–	–

Appendix B
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SAP and BRUKL 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 Residential – TER from the TER SAP worksheet for Flat 6, 7 and 8. DER from Existing scenario DER SAP worksheet for Flat 1 to 5
- Be Lean Residential – DER from the Be Lean scenario DER SAP worksheet
- Be Green Residential – DER from the Be Green scenario DER SAP worksheet

- Baseline Non-domestic – TER from the Be Lean scenario BRUKL
- Be Lean Non-domestic – BER from the Be Lean scenario BRUKL
- Be Green Non-domestic – BER from the Be Green scenario BRUKL

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Baseline Residential – TER from the TER SAP worksheet for Flat 6, 7 and 8. DER from Existing scenario DER SAP worksheet for Flat 1 to 5

DER WorkSheet: Existing dwelling (SAP)

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 01-Baseline

Address : Flat 01, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	71.6	(1a)	x	2.7	(2a)	=	193.32	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.6	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			193.32	(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)		1	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(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		0.05	(13)
Percentage of windows and doors draught stripped		1	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.248	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.80318311664347	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		0	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.8	(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) =	0.68	(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

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.87	0.85	0.84	0.75	0.73	0.65	0.65	0.63	0.68	0.73	0.77	0.8

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=	0.88	0.86	0.85	0.78	0.77	0.71	0.71	0.7	0.73	0.77	0.79	0.82	(24d)

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

(25)m=	0.88	0.86	0.85	0.78	0.77	0.71	0.71	0.7	0.73	0.77	0.79	0.82	(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			3	x	1.6	=	4.8			(26)
Windows Type 1			2.36	x1/[1/(1.6)+ 0.04]		=	3.55			(27)
Windows Type 2			1.93	x1/[1/(1.6)+ 0.04]		=	2.9			(27)
Windows Type 3			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Floor			71.6	x	0.55	=	39.38			(28)
Walls Type1	52.87	13.38	39.49	x	0.55	=	21.72			(29)
Walls Type2	32.34	0	32.34	x	0.14	=	4.64			(29)
Total area of elements, m²			156.81							(31)
Party wall			20.9	x	0	=	0			(32)
Party ceiling			71.6							(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) = 86.14 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16100.47 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 23.52 (36)

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

Total fabric heat loss (33) + (36) = 109.67 (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: Existing dwelling (SAP)

(38)m=	56.07	55.13	54.21	49.89	49.08	45.32	45.32	44.62	46.76	49.08	50.71	52.42	(38)

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

(39)m=	165.73	164.79	163.87	159.55	158.74	154.98	154.98	154.28	156.43	158.74	160.38	162.09	

Average = $Sum(39)_{1...12}$ /12= 159.55 (39)

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

(40)m=	2.31	2.3	2.29	2.23	2.22	2.16	2.16	2.15	2.18	2.22	2.24	2.26	

Average = $Sum(40)_{1...12}$ /12= 2.23 (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 2.28 (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 88.45 (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=	97.3	93.76	90.22	86.68	83.15	79.61	79.61	83.15	86.68	90.22	93.76	97.3	

Total = $Sum(44)_{1...12}$ = 1061.44 (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=	144.29	126.2	130.22	113.53	108.94	94	87.11	99.96	101.15	117.88	128.68	139.74	

Total = $Sum(45)_{1...12}$ = 1391.71 (45)

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

(46)m=	21.64	18.93	19.53	17.03	16.34	14.1	13.07	14.99	15.17	17.68	19.3	20.96	(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)

DER WorkSheet: Existing dwelling (SAP)

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=	49.58	43.16	45.98	42.75	42.37	39.26	40.57	42.37	42.75	45.98	46.24	49.58	(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=	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32	(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=	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32

Output from water heater (annual)$_{1...12}$ | 1922.28 | (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=	60.37	52.75	54.79	48.44	46.81	41.07	39.11	43.83	44.32	50.69	54.35	58.86	(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=	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	(66)

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

(67)m=	23.85	21.18	17.23	13.04	9.75	8.23	8.89	11.56	15.52	19.7	22.99	24.51	(67)

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

(68)m=	201	203.09	197.83	186.64	172.52	159.24	150.37	148.29	153.54	164.73	178.86	192.13	(68)

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

(69)m=	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	(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=	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	(71)

Water heating gains (Table 5)

(72)m=	81.15	78.5	73.65	67.27	62.92	57.04	52.56	58.91	61.56	68.13	75.48	79.11	(72)

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

(73)m=	366.26	363.03	348.97	327.22	305.45	284.78	272.09	279.02	290.88	312.83	337.6	356.02	(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)	
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	53.07	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	90.41	(77)

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Southeast 0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	123.7	(77)
Southeast 0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	153.27	(77)
Southeast 0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	171.67	(77)
Southeast 0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	170.43	(77)
Southeast 0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	164.31	(77)
Southeast 0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	150.58	(77)
Southeast 0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	133.94	(77)
Southeast 0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	99.92	(77)
Southeast 0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	63.57	(77)
Southeast 0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	45.42	(77)
Southwest 0.9x	0.77	x	1.8	x	36.79		0.63	x	0.7	=	20.24	(79)
Southwest 0.9x	0.77	x	1.8	x	62.67		0.63	x	0.7	=	34.48	(79)
Southwest 0.9x	0.77	x	1.8	x	85.75		0.63	x	0.7	=	47.17	(79)
Southwest 0.9x	0.77	x	1.8	x	106.25		0.63	x	0.7	=	58.45	(79)
Southwest 0.9x	0.77	x	1.8	x	119.01		0.63	x	0.7	=	65.47	(79)
Southwest 0.9x	0.77	x	1.8	x	118.15		0.63	x	0.7	=	64.99	(79)
Southwest 0.9x	0.77	x	1.8	x	113.91		0.63	x	0.7	=	62.66	(79)
Southwest 0.9x	0.77	x	1.8	x	104.39		0.63	x	0.7	=	57.43	(79)
Southwest 0.9x	0.77	x	1.8	x	92.85		0.63	x	0.7	=	51.08	(79)
Southwest 0.9x	0.77	x	1.8	x	69.27		0.63	x	0.7	=	38.1	(79)
Southwest 0.9x	0.77	x	1.8	x	44.07		0.63	x	0.7	=	24.24	(79)
Southwest 0.9x	0.77	x	1.8	x	31.49		0.63	x	0.7	=	17.32	(79)
Northwest 0.9x	0.77	x	1.93	x	11.28	x	0.63	x	0.7	=	13.31	(81)
Northwest 0.9x	0.77	x	1.93	x	22.97	x	0.63	x	0.7	=	27.09	(81)
Northwest 0.9x	0.77	x	1.93	x	41.38	x	0.63	x	0.7	=	48.81	(81)
Northwest 0.9x	0.77	x	1.93	x	67.96	x	0.63	x	0.7	=	80.17	(81)
Northwest 0.9x	0.77	x	1.93	x	91.35	x	0.63	x	0.7	=	107.76	(81)
Northwest 0.9x	0.77	x	1.93	x	97.38	x	0.63	x	0.7	=	114.88	(81)
Northwest 0.9x	0.77	x	1.93	x	91.1	x	0.63	x	0.7	=	107.47	(81)
Northwest 0.9x	0.77	x	1.93	x	72.63	x	0.63	x	0.7	=	85.68	(81)
Northwest 0.9x	0.77	x	1.93	x	50.42	x	0.63	x	0.7	=	59.48	(81)
Northwest 0.9x	0.77	x	1.93	x	28.07	x	0.63	x	0.7	=	33.11	(81)
Northwest 0.9x	0.77	x	1.93	x	14.2	x	0.63	x	0.7	=	16.75	(81)
Northwest 0.9x	0.77	x	1.93	x	9.21	x	0.63	x	0.7	=	10.87	(81)

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

(83)m=	86.63	151.98	219.68	291.88	344.9	350.31	334.44	293.68	244.5	171.13	104.56	73.61	(83)

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

(84)m=	452.89	515.01	568.66	619.1	650.35	635.09	606.54	572.71	535.38	483.96	442.16	429.63	(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: Existing dwelling (SAP)

(86)m=	1	0.99	0.99	0.98	0.95	0.89	0.8	0.83	0.94	0.98	0.99	1	(86)

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

(87)m=	18.49	18.68	19.03	19.55	20.06	20.53	20.78	20.74	20.36	19.71	19.04	18.5	(87)

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

(88)m=	19.13	19.14	19.15	19.19	19.19	19.23	19.23	19.23	19.21	19.19	19.18	19.16	(88)

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

(89)m=	0.99	0.99	0.99	0.97	0.92	0.8	0.59	0.65	0.88	0.97	0.99	1	(89)

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

(90)m=	16.96	17.15	17.5	18.04	18.55	19	19.17	19.16	18.85	18.21	17.54	16.98	(90)

fLA = Living area ÷ (4) = 0.32 (91)

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

(92)m=	17.46	17.65	18	18.53	19.04	19.49	19.7	19.67	19.34	18.7	18.03	17.48	(92)

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

(93)m=	17.46	17.65	18	18.53	19.04	19.49	19.7	19.67	19.34	18.7	18.03	17.48	(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	0.96	0.92	0.82	0.66	0.71	0.89	0.97	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	449.67	509.35	557.95	596.02	598.03	521.42	402.48	406.24	475.98	468.92	437.3	427.09	(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=	2180.65	2100.47	1884.61	1536.86	1164.81	758.6	479.86	505.07	820.21	1285.59	1752.38	2151.96	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1287.85	1069.23	987.03	677.41	421.68	0	0	0	0	607.6	946.86	1283.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 7280.98 (98)

Space heating requirement in kWh/m²/year 101.69 (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)													
	1287.85	1069.23	987.03	677.41	421.68	0	0	0	0	607.6	946.86	1283.31	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1426.19	1184.09	1093.06	750.18	466.98	0	0	0	0	672.87	1048.57	1421.16	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 8063.1 (211)

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

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

Water heating

Output from water heater (calculated above)

	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32		
Efficiency of water heater													81	(216)
(217)m=	88.96	88.9	88.76	88.4	87.64	81	81	81	81	88.15	88.71	88.99		(217)

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

(219)m=	217.92	190.49	198.52	176.79	172.64	164.52	157.63	175.72	177.66	185.89	197.17	212.75		
									Total = Sum(219a)$_{1...12}$ =				2227.7	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8063.1	
Water heating fuel used			2227.7	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			421.2	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1741.63	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	481.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2222.81	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	218.6	(268)
Total CO2, kg/year			sum of (265)…(271) =		2456.98	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		34.32	(273)
EI rating (section 14)					72	(274)

DER WorkSheet: Existing dwelling (SAP)

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 02-Baseline

Address : Flat 02, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	68.42	(1a)	x	3.13	(2a)	=	214.15	(3a)
First floor	29.89	(1b)	x	2.2	(2b)	=	65.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	279.91	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.11	(8)

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

Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9)-1]x0.1 =	0.1	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(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		0.05	(13)
Percentage of windows and doors draught stripped		1	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.248	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.855176310627718	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		0	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.86	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

DER WorkSheet: Existing dwelling (SAP)

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

0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.86	(24d)

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

(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	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			1.98	x	1.6	=	3.168			(26)
Windows Type 1			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 2			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 3			2.55	x1/[1/(1.6)+ 0.04]		=	3.83			(27)
Windows Type 4			2.34	x1/[1/(1.6)+ 0.04]		=	3.52			(27)
Windows Type 5			0.81	x1/[1/(1.6)+ 0.04]		=	1.22			(27)
Windows Type 6			0.74	x1/[1/(1.6)+ 0.04]		=	1.11			(27)
Windows Type 7			2.49	x1/[1/(1.6)+ 0.04]		=	3.74			(27)
Floor			18.51	x	0.55	=	10.1805			(28)
Walls Type1	60.8	13.01	47.79	x	0.55	=	26.28			(29)
Walls Type2	29.23	1.98	27.25	x	0.14	=	3.91			(29)
Walls Type3	2.83	0	2.83	x	0.15	=	0.42			(29)
Roof	20.68	0	20.68	x	0.18	=	3.72			(30)
Total area of elements, m²			132.05							(31)
Party wall			92.15	x	0	=	0			(32)
Party floor			49.91							(32a)
Party ceiling			47.74							(32b)

DER WorkSheet: Existing dwelling (SAP)

** 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) =	67.25	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13532.85	(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		19.81	(36)

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

Total fabric heat loss	(33) + (36) =	87.06	(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=	85.86	84.32	82.81	75.71	74.39	68.21	68.21	67.07	70.59	74.39	77.07	79.88	(38)

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

(39)m=	172.91	171.37	169.86	162.77	161.44	155.27	155.27	154.12	157.65	161.44	164.13	166.94	

Average = Sum(39)1…12 /12= 162.76 (39)

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

(40)m=	1.76	1.74	1.73	1.66	1.64	1.58	1.58	1.57	1.6	1.64	1.67	1.7	

Average = Sum(40)1…12 /12= 1.66 (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 2.72 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.88 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	108.77	104.81	100.86	96.9	92.95	88.99	88.99	92.95	96.9	100.86	104.81	108.77	

Total = Sum(44)1…12 = 1186.55 (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=	161.3	141.07	145.57	126.91	121.78	105.08	97.38	111.74	113.08	131.78	143.85	156.21	

Total = Sum(45)1…12 = 1555.75 (45)

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

(46)m=	24.19	21.16	21.84	19.04	18.27	15.76	14.61	16.76	16.96	19.77	21.58	23.43	(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)

DER WorkSheet: Existing dwelling (SAP)

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	47.79	47.36	43.89	45.35	47.36	47.79	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=	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17	(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=	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17	

Output from water heater (annual)$_{1…12}$ — 2134.46 (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=	66.37	58.41	61.14	54.15	52.33	45.91	43.71	49	49.54	56.56	60.16	64.68	(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=	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	30.69	27.26	22.17	16.78	12.55	10.59	11.44	14.88	19.97	25.35	29.59	31.54	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	253.57	256.2	249.57	235.45	217.63	200.89	189.7	187.07	193.7	207.81	225.63	242.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	(71)

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Water heating gains (Table 5)

(72)m=	89.21	86.92	82.18	75.2	70.34	63.77	58.76	65.85	68.81	76.02	83.55	86.93	(72)

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

(73)m=	440.32	437.23	420.77	394.29	367.37	342.09	326.75	334.65	349.33	376.03	405.62	427.71	(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)	
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast	0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast	0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast	0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast	0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast	0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast	0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast	0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast	0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast	0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast	0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast	0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Southeast	0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southwest	0.9x	0.77	x	2.49	x	36.79		0.63	x	0.7	=	28	(79)
Southwest	0.9x	0.77	x	2.49	x	62.67		0.63	x	0.7	=	47.69	(79)
Southwest	0.9x	0.77	x	2.49	x	85.75		0.63	x	0.7	=	65.26	(79)
Southwest	0.9x	0.77	x	2.49	x	106.25		0.63	x	0.7	=	80.85	(79)
Southwest	0.9x	0.77	x	2.49	x	119.01		0.63	x	0.7	=	90.56	(79)
Southwest	0.9x	0.77	x	2.49	x	118.15		0.63	x	0.7	=	89.91	(79)
Southwest	0.9x	0.77	x	2.49	x	113.91		0.63	x	0.7	=	86.68	(79)
Southwest	0.9x	0.77	x	2.49	x	104.39		0.63	x	0.7	=	79.44	(79)

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Southwest	0.9x	0.77	x	2.49	x	92.85		0.63	x	0.7	=	70.66	(79)
Southwest	0.9x	0.77	x	2.49	x	69.27		0.63	x	0.7	=	52.71	(79)
Southwest	0.9x	0.77	x	2.49	x	44.07		0.63	x	0.7	=	33.54	(79)
Southwest	0.9x	0.77	x	2.49	x	31.49		0.63	x	0.7	=	23.96	(79)
Northwest	0.9x	0.77	x	2.55	x	11.28	x	0.63	x	0.7	=	8.79	(81)
Northwest	0.9x	0.77	x	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	0.81	x	11.28	x	0.63	x	0.7	=	2.79	(81)
Northwest	0.9x	0.77	x	0.74	x	11.28	x	0.63	x	0.7	=	2.55	(81)
Northwest	0.9x	0.77	x	2.55	x	22.97	x	0.63	x	0.7	=	17.9	(81)
Northwest	0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	0.81	x	22.97	x	0.63	x	0.7	=	5.69	(81)
Northwest	0.9x	0.77	x	0.74	x	22.97	x	0.63	x	0.7	=	5.19	(81)
Northwest	0.9x	0.77	x	2.55	x	41.38	x	0.63	x	0.7	=	32.25	(81)
Northwest	0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(81)
Northwest	0.9x	0.77	x	0.81	x	41.38	x	0.63	x	0.7	=	10.24	(81)
Northwest	0.9x	0.77	x	0.74	x	41.38	x	0.63	x	0.7	=	9.36	(81)
Northwest	0.9x	0.77	x	2.55	x	67.96	x	0.63	x	0.7	=	52.96	(81)
Northwest	0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(81)
Northwest	0.9x	0.77	x	0.81	x	67.96	x	0.63	x	0.7	=	16.82	(81)
Northwest	0.9x	0.77	x	0.74	x	67.96	x	0.63	x	0.7	=	15.37	(81)
Northwest	0.9x	0.77	x	2.55	x	91.35	x	0.63	x	0.7	=	71.19	(81)
Northwest	0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(81)
Northwest	0.9x	0.77	x	0.81	x	91.35	x	0.63	x	0.7	=	22.61	(81)
Northwest	0.9x	0.77	x	0.74	x	91.35	x	0.63	x	0.7	=	20.66	(81)
Northwest	0.9x	0.77	x	2.55	x	97.38	x	0.63	x	0.7	=	75.89	(81)
Northwest	0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(81)
Northwest	0.9x	0.77	x	0.81	x	97.38	x	0.63	x	0.7	=	24.11	(81)
Northwest	0.9x	0.77	x	0.74	x	97.38	x	0.63	x	0.7	=	22.02	(81)
Northwest	0.9x	0.77	x	2.55	x	91.1	x	0.63	x	0.7	=	71	(81)
Northwest	0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(81)
Northwest	0.9x	0.77	x	0.81	x	91.1	x	0.63	x	0.7	=	22.55	(81)
Northwest	0.9x	0.77	x	0.74	x	91.1	x	0.63	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	2.55	x	72.63	x	0.63	x	0.7	=	56.6	(81)
Northwest	0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(81)
Northwest	0.9x	0.77	x	0.81	x	72.63	x	0.63	x	0.7	=	17.98	(81)
Northwest	0.9x	0.77	x	0.74	x	72.63	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	2.55	x	50.42	x	0.63	x	0.7	=	39.29	(81)
Northwest	0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(81)
Northwest	0.9x	0.77	x	0.81	x	50.42	x	0.63	x	0.7	=	12.48	(81)
Northwest	0.9x	0.77	x	0.74	x	50.42	x	0.63	x	0.7	=	11.4	(81)
Northwest	0.9x	0.77	x	2.55	x	28.07	x	0.63	x	0.7	=	21.87	(81)

Northwest 0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(81)
Northwest 0.9x	0.77	x	0.81	x	28.07	x	0.63	x	0.7	=	6.95	(81)
Northwest 0.9x	0.77	x	0.74	x	28.07	x	0.63	x	0.7	=	6.35	(81)
Northwest 0.9x	0.77	x	2.55	x	14.2	x	0.63	x	0.7	=	11.06	(81)
Northwest 0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(81)
Northwest 0.9x	0.77	x	0.81	x	14.2	x	0.63	x	0.7	=	3.51	(81)
Northwest 0.9x	0.77	x	0.74	x	14.2	x	0.63	x	0.7	=	3.21	(81)
Northwest 0.9x	0.77	x	2.55	x	9.21	x	0.63	x	0.7	=	7.18	(81)
Northwest 0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(81)
Northwest 0.9x	0.77	x	0.81	x	9.21	x	0.63	x	0.7	=	2.28	(81)
Northwest 0.9x	0.77	x	0.74	x	9.21	x	0.63	x	0.7	=	2.08	(81)

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

(83)m=	96.08	171.04	253.62	347.09	418.74	428.9	408.02	352.54	285.67	194.32	116.43	81.36	(83)

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

(84)m=	536.4	608.27	674.39	741.37	786.11	770.99	734.77	687.19	635	570.35	522.05	509.07	(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	0.96	0.88	0.77	0.81	0.94	0.99	1	1	(86)

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

(87)m=	18.98	19.14	19.45	19.92	20.34	20.72	20.89	20.86	20.57	20.02	19.46	19.01	(87)

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

(88)m=	19.5	19.51	19.52	19.57	19.58	19.63	19.63	19.64	19.61	19.58	19.56	19.54	(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	0.66	0.9	0.98	1	1	(89)

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

(90)m=	17.7	17.87	18.19	18.69	19.11	19.48	19.6	19.59	19.35	18.8	18.23	17.76	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.12	18.29	18.6	19.09	19.52	19.89	20.03	20.01	19.75	19.2	18.64	18.17	(92)

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

(93)m=	18.12	18.29	18.6	19.09	19.52	19.89	20.03	20.01	19.75	19.2	18.64	18.17	(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	0.93	0.82	0.65	0.71	0.9	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	534.57	604.78	666.85	721.69	731.95	633.65	480.22	485.81	574.51	558.98	519.12	507.69	(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=	2389.79	2295.15	2055.99	1658.99	1261.97	821.89	532.02	556.89	890.8	1389.23	1893.66	2332.11	(97)

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

(98)m=	1380.28	1135.92	1033.52	674.85	394.33	0	0	0	0	617.71	989.67	1357.36	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 7583.65 (98)

Space heating requirement in kWh/m²/year 77.14 (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)	1380.28	1135.92	1033.52	674.85	394.33	0	0	0	0	617.71	989.67	1357.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1528.55	1257.94	1144.54	747.35	436.69	0	0	0	0	684.06	1095.98	1503.17	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 8398.29 (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)

	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17	
Efficiency of water heater													81 (216)
(217)m=	88.94	88.86	88.67	88.22	87.29	81	81	81	81	87.99	88.64	88.95	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	238.65	210.56	221.64	198.04	193.77	183.91	176.2	196.43	198.6	207.67	217.92	232.91

Total = $Sum(219a)_{1...12}$ = 2476.3 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8398.29	
Water heating fuel used			2476.3	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			542.02	(232)

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

DER WorkSheet: Existing dwelling (SAP)

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1814.03	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	534.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2348.91	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	281.31	(268)
Total CO2, kg/year			sum of (265)…(271) =		2645.79	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		26.91	(273)
EI rating (section 14)					75	(274)

DER WorkSheet: Existing dwelling (SAP)

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 03-Baseline

Address : Flat 03, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.13	(1a) x	3.33	(2a) =	186.91	(3a)
First floor	45.8	(1b) x	2.2	(2b) =	100.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	101.93	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	287.67	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.1	(8)

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

Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9)-1]x0.1 =	0.1	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(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		0.05	(13)
Percentage of windows and doors draught stripped		1	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.248	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.852285110008465	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		0	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.85	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.66	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

DER WorkSheet: Existing dwelling (SAP)

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

0.84	0.83	0.81	0.73	0.71	0.63	0.63	0.61	0.66	0.71	0.74	0.78

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=	0.85	0.84	0.83	0.76	0.75	0.7	0.7	0.69	0.72	0.75	0.78	0.8	(24d)

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

(25)m=	0.85	0.84	0.83	0.76	0.75	0.7	0.7	0.69	0.72	0.75	0.78	0.8	(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			1.98	x	1.6	=	3.168			(26)
Windows Type 1			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 2			2.28	x1/[1/(1.6)+ 0.04]		=	3.43			(27)
Windows Type 3			2.34	x1/[1/(1.6)+ 0.04]		=	3.52			(27)
Floor			59.1	x	0.55	=	32.505			(28)
Walls Type1	70.52	12.54	57.98	x	0.55	=	31.89			(29)
Walls Type2	33.65	1.98	31.67	x	0.14	=	4.54			(29)
Roof	20.55	0	20.55	x	0.18	=	3.7			(30)
Total area of elements, m²			183.82							(31)
Party wall			51.98	x	0	=	0			(32)
Party floor			5.32							(32a)
Party ceiling			43.87							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 94.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13345 (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 | 27.57 | (36)

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

Total fabric heat loss (33) + (36) = | 122.23 | (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=	81.13	79.82	78.54	72.52	71.4	66.16	66.16	65.19	68.17	71.4	73.68	76.06	(38)

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

(39)m=	203.36	202.05	200.77	194.75	193.63	188.39	188.39	187.42	190.41	193.63	195.91	198.29	

Average = Sum(39)$_{1...12}$ /12= | 194.75 | (39)

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

(40)m=	2	1.98	1.97	1.91	1.9	1.85	1.85	1.84	1.87	1.9	1.92	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 | 2.76 | (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 | 99.67 | (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=	109.64	105.65	101.66	97.68	93.69	89.7	89.7	93.69	97.68	101.66	105.65	109.64

Total = Sum(44)$_{1...12}$ = | 1196.06 | (44)

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

(45)m=	162.59	142.2	146.74	127.93	122.75	105.93	98.16	112.64	113.98	132.84	145	157.46

Total = Sum(45)$_{1...12}$ = | 1568.22 | (45)

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

(46)m=	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.9	17.1	19.93	21.75	23.62	(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: Existing dwelling (SAP)

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	48.17	47.74	44.24	45.71	47.74	48.17	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=	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42	(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=	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42	

Output from water heater (annual)$_{1…12}$ — 2149.17 (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=	66.8	58.79	61.53	54.58	52.75	46.28	44.07	49.39	49.94	56.91	60.54	65.1	(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=	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	(66)

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

(67)m=	31.91	28.34	23.05	17.45	13.04	11.01	11.9	15.47	20.76	26.36	30.77	32.8	(67)

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

(68)m=	259.41	262.1	255.32	240.88	222.65	205.52	194.07	191.38	198.16	212.6	230.83	247.96	(68)

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

(69)m=	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(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=	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)

Water heating gains (Table 5)

(72)m=	89.79	87.48	82.7	75.81	70.9	64.28	59.23	66.38	69.36	76.49	84.09	87.49	(72)

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

(73)m=	448.46	445.28	428.42	401.48	373.95	348.16	332.55	340.58	355.64	382.8	413.03	435.61	(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: Existing dwelling (SAP)

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(75)
Northeast 0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(75)
Northeast 0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(75)
Northeast 0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(75)
Northeast 0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(75)
Northeast 0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(75)
Northeast 0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(75)
Northeast 0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(75)
Northeast 0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(75)
Northeast 0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(75)
Northeast 0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(75)
Northeast 0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(75)
Southeast 0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	89.06	(77)
Southeast 0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	151.7	(77)
Southeast 0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	207.56	(77)
Southeast 0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	257.18	(77)
Southeast 0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	288.06	(77)
Southeast 0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	285.98	(77)
Southeast 0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	275.71	(77)
Southeast 0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	252.67	(77)
Southeast 0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	224.74	(77)
Southeast 0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	167.66	(77)
Southeast 0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	106.67	(77)
Southeast 0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	76.21	(77)
Southwest 0.9x	0.77	x	2.28	x	36.79		0.63	x	0.7	=	25.64	(79)
Southwest 0.9x	0.77	x	2.28	x	62.67		0.63	x	0.7	=	43.67	(79)
Southwest 0.9x	0.77	x	2.28	x	85.75		0.63	x	0.7	=	59.75	(79)
Southwest 0.9x	0.77	x	2.28	x	106.25		0.63	x	0.7	=	74.04	(79)
Southwest 0.9x	0.77	x	2.28	x	119.01		0.63	x	0.7	=	82.93	(79)
Southwest 0.9x	0.77	x	2.28	x	118.15		0.63	x	0.7	=	82.33	(79)
Southwest 0.9x	0.77	x	2.28	x	113.91		0.63	x	0.7	=	79.37	(79)
Southwest 0.9x	0.77	x	2.28	x	104.39		0.63	x	0.7	=	72.74	(79)
Southwest 0.9x	0.77	x	2.28	x	92.85		0.63	x	0.7	=	64.7	(79)
Southwest 0.9x	0.77	x	2.28	x	69.27		0.63	x	0.7	=	48.27	(79)
Southwest 0.9x	0.77	x	2.28	x	44.07		0.63	x	0.7	=	30.71	(79)
Southwest 0.9x	0.77	x	2.28	x	31.49		0.63	x	0.7	=	21.94	(79)

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

(83)m=	122.76	211.79	296.9	379.81	436.31	437.95	420.23	377.35	325.5	236	147.53	104.74	(83)

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

(84)m=	571.22	657.07	725.33	781.29	810.26	786.1	752.78	717.93	681.14	618.8	560.56	540.35	(84)

DER WorkSheet: Existing dwelling (SAP)

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	0.96	0.91	0.81	0.84	0.95	0.99	1	1	(86)

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

(87)m=	18.74	18.92	19.24	19.72	20.17	20.6	20.82	20.79	20.46	19.86	19.25	18.75	(87)

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

(88)m=	19.34	19.35	19.35	19.39	19.4	19.44	19.44	19.44	19.42	19.4	19.39	19.37	(88)

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

(89)m=	1	0.99	0.99	0.98	0.94	0.83	0.63	0.68	0.9	0.98	0.99	1	(89)

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

(90)m=	17.35	17.53	17.86	18.36	18.81	19.23	19.39	19.38	19.1	18.51	17.89	17.38	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)m=	17.73	17.91	18.24	18.73	19.18	19.6	19.78	19.76	19.47	18.88	18.26	17.75	(92)

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

(93)m=	17.73	17.91	18.24	18.73	19.18	19.6	19.78	19.76	19.47	18.88	18.26	17.75	(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	0.94	0.84	0.68	0.73	0.9	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	568.72	652.23	715.58	759.34	757.77	662.19	513.28	520.58	614.94	604.16	556.53	538.44	(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=	2730.66	2628.57	2356.13	1913.57	1448.21	941.6	598.54	629.75	1021.62	1602.83	2186.44	2687.69	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1608.48	1328.1	1220.58	831.05	513.69	0	0	0	0	743	1173.54	1599.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 9017.48 | (98)

Space heating requirement in kWh/m²/year | 88.47 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

DER WorkSheet: Existing dwelling (SAP)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1608.48	1328.1	1220.58	831.05	513.69	0	0	0	0	743	1173.54	1599.04		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1781.27	1470.77	1351.69	920.32	568.87	0	0	0	0	822.82	1299.6	1770.81		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													9986.14	(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)														
	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42		
Efficiency of water heater													81	(216)
(217)m=	89.1	89.03	88.88	88.52	87.79	81	81	81	81	88.29	88.85	89.12		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	239.67	211.42	222.44	198.93	194.21	185.39	177.62	198	200.19	208.17	218.7	233.86		
Total = Sum(219a)$_{1...12}$ =													2488.61	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			9986.14	
Water heating fuel used			2488.61	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			563.55	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	2157.01	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	537.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2694.55	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	292.48	(268)
Total CO2, kg/year			sum of (265)…(271) =		3002.6	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		29.46	(273)
EI rating (section 14)					73	(274)

DER WorkSheet: Existing dwelling (SAP)

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 04-Baseline

Address : Flat 04, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83.77	(1a)	x	3.06	(2a)	=	256.34	(3a)
First floor	20.32	(1b)	x	2.2	(2b)	=	44.7	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	104.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	301.04	(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) =	0.13	(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)		2	(9)
Additional infiltration	[(9)-1]x0.1 =	0.1	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(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		0.05	(13)
Percentage of windows and doors draught stripped		1	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.248	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.880872626188352	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		0	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.81	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

DER WorkSheet: Existing dwelling (SAP)

Wind Factor (22a)m = (22)m ÷ 4

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

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

1.04	1.02	1	0.9	0.88	0.77	0.77	0.75	0.81	0.88	0.92	0.96

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	1.04	1.02	1	0.9	0.88	0.8	0.8	0.78	0.83	0.88	0.92	0.96	(24d)

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

(25)m=	1.04	1.02	1	0.9	0.88	0.8	0.8	0.78	0.83	0.88	0.92	0.96	(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			1.98	x	1.6	=	3.168			(26)
Windows Type 1			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 2			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 3			0.69	x1/[1/(1.6)+ 0.04]		=	1.04			(27)
Windows Type 4			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Windows Type 5			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 6			8.66	x1/[1/(1.6)+ 0.04]		=	13.02			(27)
Windows Type 7			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Floor			83.77	x	0.55	=	46.0735			(28)
Walls Type1	55.67	9.01	46.66	x	0.55	=	25.66			(29)
Walls Type2	19.9	1.98	17.92	x	0.14	=	2.57			(29)
Walls Type3	36.42	11.9	24.52	x	0.15	=	3.68			(29)
Roof	13.01	0	13.01	x	0.18	=	2.34			(30)
Total area of elements, m²			208.77							(31)
Party wall			58.33	x	0	=	0			(32)
Party ceiling			70.76							(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) = 114.94 (33)

DER WorkSheet: Existing dwelling (SAP)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18376.29 (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 31.32 (36)

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

Total fabric heat loss (33) + (36) = 146.25 (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=	103.21	101.18	99.16	89.57	87.78	79.43	79.43	77.89	82.65	87.78	91.41	95.2	(38)

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

(39)m=	249.46	247.43	245.41	235.83	234.03	225.69	225.69	224.14	228.9	234.03	237.66	241.45

Average = Sum(39)1…12 /12= 235.81 (39)

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

(40)m=	2.4	2.38	2.36	2.27	2.25	2.17	2.17	2.15	2.2	2.25	2.28	2.32

Average = Sum(40)1…12 /12= 2.27 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.77 (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) + 36 100.09 (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=	110.1	106.09	102.09	98.09	94.08	90.08	90.08	94.08	98.09	102.09	106.09	110.1

Total = Sum(44)1…12 = 1201.08 (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=	163.27	142.8	147.36	128.47	123.27	106.37	98.57	113.11	114.46	133.39	145.61	158.12

Total = Sum(45)1…12 = 1574.8 (45)

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

(46)m=	24.49	21.42	22.1	19.27	18.49	15.96	14.79	16.97	17.17	20.01	21.84	23.72	(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:

DER WorkSheet: Existing dwelling (SAP)

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	48.37	47.94	44.42	45.9	47.94	48.37	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=	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08	(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=	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08	

Output from water heater (annual)$_{1...12}$ | 2156.94 | (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=	67.03	58.99	61.74	54.81	52.97	46.47	44.25	49.59	50.15	57.09	60.74	65.32	(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=	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	29.48	26.18	21.29	16.12	12.05	10.17	10.99	14.29	19.18	24.35	28.42	30.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	262.78	265.5	258.63	244	225.54	208.18	196.59	193.86	200.73	215.36	233.83	251.18	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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=	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating gains (Table 5)													
(72)m=	90.09	87.78	82.98	76.12	71.2	64.55	59.48	66.66	69.65	76.74	84.37	87.79	(72)

DER WorkSheet: Existing dwelling (SAP)

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

(73)m=	449.96	447.08	430.51	403.86	376.4	350.52	334.67	342.42	357.18	384.06	414.22	436.88	(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	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast	0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)
Northeast	0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast	0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast	0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast	0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast	0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast	0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast	0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast	0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast	0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast	0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
East	0.9x	0.77	x	0.69	x	19.64	x	0.63	x	0.7	=	4.14	(76)
East	0.9x	0.77	x	1.8	x	19.64	x	0.63	x	0.7	=	10.8	(76)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(76)
East	0.9x	0.77	x	0.69	x	38.42	x	0.63	x	0.7	=	8.1	(76)
East	0.9x	0.77	x	1.8	x	38.42	x	0.63	x	0.7	=	21.14	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(76)
East	0.9x	0.77	x	0.69	x	63.27	x	0.63	x	0.7	=	13.34	(76)
East	0.9x	0.77	x	1.8	x	63.27	x	0.63	x	0.7	=	34.81	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(76)
East	0.9x	0.77	x	0.69	x	92.28	x	0.63	x	0.7	=	19.46	(76)
East	0.9x	0.77	x	1.8	x	92.28	x	0.63	x	0.7	=	50.76	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(76)
East	0.9x	0.77	x	0.69	x	113.09	x	0.63	x	0.7	=	23.85	(76)
East	0.9x	0.77	x	1.8	x	113.09	x	0.63	x	0.7	=	62.21	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(76)
East	0.9x	0.77	x	0.69	x	115.77	x	0.63	x	0.7	=	24.41	(76)
East	0.9x	0.77	x	1.8	x	115.77	x	0.63	x	0.7	=	63.69	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(76)
East	0.9x	0.77	x	0.69	x	110.22	x	0.63	x	0.7	=	23.24	(76)
East	0.9x	0.77	x	1.8	x	110.22	x	0.63	x	0.7	=	60.63	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	0.69	x	94.68	x	0.63	x	0.7	=	19.96	(76)

DER WorkSheet: Existing dwelling (SAP)

East	0.9x	0.77	x	1.8	x	94.68	x	0.63	x	0.7	=	52.08	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(76)
East	0.9x	0.77	x	0.69	x	73.59	x	0.63	x	0.7	=	15.52	(76)
East	0.9x	0.77	x	1.8	x	73.59	x	0.63	x	0.7	=	40.48	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(76)
East	0.9x	0.77	x	0.69	x	45.59	x	0.63	x	0.7	=	9.61	(76)
East	0.9x	0.77	x	1.8	x	45.59	x	0.63	x	0.7	=	25.08	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(76)
East	0.9x	0.77	x	0.69	x	24.49	x	0.63	x	0.7	=	5.16	(76)
East	0.9x	0.77	x	1.8	x	24.49	x	0.63	x	0.7	=	13.47	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(76)
East	0.9x	0.77	x	0.69	x	16.15	x	0.63	x	0.7	=	3.41	(76)
East	0.9x	0.77	x	1.8	x	16.15	x	0.63	x	0.7	=	8.88	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(76)
Southeast	0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast	0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast	0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast	0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast	0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast	0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast	0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast	0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast	0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast	0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast	0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast	0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Northwest	0.9x	0.77	x	8.66	x	11.28	x	0.63	x	0.7	=	29.86	(81)
Northwest	0.9x	0.77	x	8.66	x	22.97	x	0.63	x	0.7	=	60.78	(81)
Northwest	0.9x	0.77	x	8.66	x	41.38	x	0.63	x	0.7	=	109.51	(81)

Northwest	0.9x	0.77	x	8.66	x	67.96	x	0.63	x	0.7	=	179.85	(81)
Northwest	0.9x	0.77	x	8.66	x	91.35	x	0.63	x	0.7	=	241.76	(81)
Northwest	0.9x	0.77	x	8.66	x	97.38	x	0.63	x	0.7	=	257.74	(81)
Northwest	0.9x	0.77	x	8.66	x	91.1	x	0.63	x	0.7	=	241.11	(81)
Northwest	0.9x	0.77	x	8.66	x	72.63	x	0.63	x	0.7	=	192.21	(81)
Northwest	0.9x	0.77	x	8.66	x	50.42	x	0.63	x	0.7	=	133.44	(81)
Northwest	0.9x	0.77	x	8.66	x	28.07	x	0.63	x	0.7	=	74.28	(81)
Northwest	0.9x	0.77	x	8.66	x	14.2	x	0.63	x	0.7	=	37.57	(81)
Northwest	0.9x	0.77	x	8.66	x	9.21	x	0.63	x	0.7	=	24.39	(81)

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

(83)m=	113.95	214.84	346.05	511.23	644.35	670.3	633.57	530.2	402.94	251.78	140.33	94.99	(83)

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

(84)m=	563.91	661.91	776.57	915.09	1020.75	1020.81	968.24	872.62	760.12	635.84	554.56	531.87	(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	0.87	0.77	0.82	0.94	0.99	1	1	(86)

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

(87)m=	18.35	18.55	18.94	19.53	20.09	20.58	20.81	20.76	20.35	19.64	18.94	18.38	(87)

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

(88)m=	19.08	19.09	19.11	19.16	19.17	19.22	19.22	19.23	19.2	19.17	19.15	19.13	(88)

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

(89)m=	1	0.99	0.99	0.97	0.91	0.77	0.55	0.63	0.89	0.98	0.99	1	(89)

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

(90)m=	16.78	16.99	17.38	18.01	18.56	19.02	19.18	19.17	18.83	18.13	17.42	16.84	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	17.31	17.51	17.9	18.52	19.07	19.54	19.72	19.7	19.34	18.64	17.93	17.35	(92)

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

(93)m=	17.31	17.51	17.9	18.52	19.07	19.54	19.72	19.7	19.34	18.64	17.93	17.35	(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	0.99	0.98	0.96	0.91	0.79	0.63	0.69	0.89	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	561.15	656.5	763.93	879.73	925.66	807.15	608.08	604.58	680.22	620.4	550.38	529.77	(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=	3244.65	3120.06	2798.46	2268.34	1724.31	1115.56	705.15	739.24	1198.75	1880.84	2573.71	3176.26	(97)

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

(98)m=	1996.53	1655.51	1513.7	999.8	594.2	0	0	0	0	937.77	1456.8	1968.99

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 11123.29 (98)

Space heating requirement in kWh/m²/year 106.86 (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)	1996.53	1655.51	1513.7	999.8	594.2	0	0	0	0	937.77	1456.8	1968.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	2210.99	1833.34	1676.3	1107.19	658.02	0	0	0	0	1038.51	1613.29	2180.5		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													12318.15	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08		
Efficiency of water heater													81	(216)
(217)m=	89.31	89.25	89.11	88.77	88.04	81	81	81	81	88.63	89.09	89.32		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	239.88	211.57	222.54	199.22	194.47	186.17	178.36	198.83	201.03	208.01	218.79	234.09		
Total = Sum(219a)$_{1...12}$ =													2492.95	(219)

Annual totals

	kWh/year	kWh/year	
Space heating fuel used, main system 1		12318.15	
Water heating fuel used		2492.95	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		30	(231)
Electricity for lighting		520.56	(232)

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

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

DER WorkSheet: Existing dwelling (SAP)

Space heating (main system 1)	(211) x	0.216	=	2660.72	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	538.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3199.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	270.17	(268)
Total CO2, kg/year		sum of (265)…(271) =		3484.94	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		33.48	(273)
EI rating (section 14)				69	(274)

DER WorkSheet: Existing dwelling (SAP)

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 05-Baseline

Address : Flat 05, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75.09	(1a)	x	2.4	(2a)	=	180.22	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			180.22	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.17	(8)

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

Number of storeys in the dwelling (ns)		1	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(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		0.05	(13)
Percentage of windows and doors draught stripped		1	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.248	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.814466907882736	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		0	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(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: Existing dwelling (SAP)

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

0.96	0.94	0.92	0.83	0.81	0.72	0.72	0.7	0.75	0.81	0.85	0.89

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=	0.96	0.94	0.93	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(24d)

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

(25)m=	0.96	0.94	0.93	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(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			1.98	x	1.6	=	3.168			(26)
Windows Type 1			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Windows Type 2			2.03	x1/[1/(1.6)+ 0.04]		=	3.05			(27)
Floor			75.09	x	0.55	=	41.2995			(28)
Walls Type1	52.54	8.3	44.24	x	0.55	=	24.33			(29)
Walls Type2	8.28	1.98	6.3	x	0.14	=	0.9			(29)
Roof	9.64	0	9.64	x	0.18	=	1.74			(30)
Total area of elements, m²			145.55							(31)
Party wall			40.53	x	0	=	0			(32)
Party ceiling			65.45							(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) = 83.92 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16157.12 (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 21.83 (36)

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

Total fabric heat loss (33) + (36) = 105.75 (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: Existing dwelling (SAP)

(38)m=	57.17	56.11	55.06	50.16	49.24	44.97	44.97	44.18	46.61	49.24	51.1	53.04	(38)

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

(39)m=	162.92	161.86	160.81	155.91	154.99	150.72	150.72	149.93	152.36	154.99	156.85	158.79

Average = Sum(39)$_{1\ldots12}$ /12= 155.9 (39)

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

(40)m=	2.17	2.16	2.14	2.08	2.06	2.01	2.01	2	2.03	2.06	2.09	2.11

Average = Sum(40)$_{1\ldots12}$ /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 — 2.36 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 90.32 (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=	99.36	95.74	92.13	88.52	84.9	81.29	81.29	84.9	88.52	92.13	95.74	99.36

Total = Sum(44)$_{1\ldots12}$ = 1083.89 (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=	147.34	128.87	132.98	115.93	111.24	95.99	88.95	102.07	103.29	120.38	131.4	142.69

Total = Sum(45)$_{1\ldots12}$ = 1421.15 (45)

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

(46)m=	22.1	19.33	19.95	17.39	16.69	14.4	13.34	15.31	15.49	18.06	19.71	21.4	(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)

DER WorkSheet: Existing dwelling (SAP)

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=	50.63	44.07	46.95	43.65	43.27	40.09	41.43	43.27	43.65	46.95	47.22	50.63	(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=	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32	(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=	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32

Output from water heater (annual)$_{1...12}$ | 1962.94 | (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=	61.65	53.87	55.95	49.46	47.8	41.94	39.93	44.76	45.26	51.76	55.49	60.1	(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=	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	(66)

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

(67)m=	26.31	23.37	19	14.39	10.75	9.08	9.81	12.75	17.11	21.73	25.36	27.04	(67)

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

(68)m=	208.87	211.04	205.58	193.95	179.27	165.48	156.26	154.1	159.56	171.18	185.86	199.66	(68)

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

(69)m=	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	(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=	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	(71)

Water heating gains (Table 5)

(72)m=	82.86	80.16	75.21	68.7	64.25	58.25	53.67	60.16	62.86	69.57	77.08	80.78	(72)

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

(73)m=	379.49	376.01	361.23	338.48	315.73	294.25	281.19	288.45	300.98	323.94	349.75	368.93	(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)	
Northeast 0.9x	0.77	x	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast 0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)

DER WorkSheet: Existing dwelling (SAP)

Northeast	0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast	0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast	0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast	0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast	0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast	0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast	0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast	0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast	0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast	0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
Southwest	0.9x	0.77	x	2.03	x	36.79		0.63	x	0.7	=	45.65	(79)
Southwest	0.9x	0.77	x	2.03	x	62.67		0.63	x	0.7	=	77.76	(79)
Southwest	0.9x	0.77	x	2.03	x	85.75		0.63	x	0.7	=	106.4	(79)
Southwest	0.9x	0.77	x	2.03	x	106.25		0.63	x	0.7	=	131.84	(79)
Southwest	0.9x	0.77	x	2.03	x	119.01		0.63	x	0.7	=	147.67	(79)
Southwest	0.9x	0.77	x	2.03	x	118.15		0.63	x	0.7	=	146.6	(79)
Southwest	0.9x	0.77	x	2.03	x	113.91		0.63	x	0.7	=	141.34	(79)
Southwest	0.9x	0.77	x	2.03	x	104.39		0.63	x	0.7	=	129.53	(79)
Southwest	0.9x	0.77	x	2.03	x	92.85		0.63	x	0.7	=	115.21	(79)
Southwest	0.9x	0.77	x	2.03	x	69.27		0.63	x	0.7	=	85.95	(79)
Southwest	0.9x	0.77	x	2.03	x	44.07		0.63	x	0.7	=	54.68	(79)
Southwest	0.9x	0.77	x	2.03	x	31.49		0.63	x	0.7	=	39.07	(79)

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

(83)m=	60.27	107.52	160.02	219.89	266.03	272.79	259.39	223.64	180.54	122.32	73.08	51.01	(83)

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

(84)m=	439.76	483.54	521.25	558.37	581.76	567.04	540.58	512.09	481.52	446.25	422.83	419.94	(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	0.99	0.97	0.92	0.84	0.87	0.96	0.99	1	1	(86)

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

(87)m=	18.59	18.75	19.08	19.57	20.06	20.52	20.77	20.73	20.36	19.74	19.12	18.61	(87)

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

(88)m=	19.22	19.23	19.24	19.28	19.29	19.33	19.33	19.34	19.31	19.29	19.27	19.26	(88)

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

(89)m=	1	0.99	0.99	0.98	0.95	0.85	0.65	0.71	0.91	0.98	0.99	1	(89)

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

(90)m=	17.12	17.29	17.62	18.14	18.62	19.08	19.27	19.25	18.93	18.32	17.68	17.16	(90)

fLA = Living area ÷ (4) = 0.36 (91)

DER WorkSheet: Existing dwelling (SAP)

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

(92)m=	17.65	17.81	18.14	18.65	19.14	19.6	19.81	19.78	19.45	18.83	18.2	17.68	(92)

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

(93)m=	17.65	17.81	18.14	18.65	19.14	19.6	19.81	19.78	19.45	18.83	18.2	17.68	(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	0.99	0.97	0.94	0.86	0.72	0.76	0.92	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	437.42	479.82	514.62	544.26	548.56	489.3	390.98	391.68	442.32	436.51	419.44	418.06	(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=	2174.91	2090.35	1872.18	1520.27	1152.57	752.99	483.48	507.35	814.56	1275.5	1741.07	2140.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1292.69	1082.27	1010.02	702.72	449.39	0	0	0	0	624.2	951.57	1281.47	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 7394.35 (98)

Space heating requirement in kWh/m²/year 98.47 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	1292.69	1082.27	1010.02	702.72	449.39	0	0	0	0	624.2	951.57	1281.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1431.55	1198.53	1118.52	778.21	497.66	0	0	0	0	691.26	1053.79	1419.13	

Total (kWh/year) =Sum(211)1...5,10...12= 8188.65 (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)

	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32

Efficiency of water heater 81 (216)

(217)m=	88.94	88.89	88.76	88.42	87.72	81	81	81	81	88.16	88.69	88.96	(217)

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

(219)m=	222.58	194.54	202.71	180.48	176.13	168	160.96	179.43	181.41	189.8	201.39	217.31

Total = Sum(219a)1...12 = 2274.76 (219)

DER WorkSheet: Existing dwelling (SAP)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8188.65	
Water heating fuel used			2274.76	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			464.59	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1768.75	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	491.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2260.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	241.12	(268)
Total CO2, kg/year		sum of (265)…(271) =		2516.79	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		33.52	(273)
EI rating (section 14)				72	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 06-Lean

Address : Flat 06, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.21	(1a) x	2.2	(2a) =	117.06	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.21	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		117.06	(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) =	0.17	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1	=	1.98			(26)
Windows Type 1			4.95	x1/[1/(1.4)+ 0.04]		=	6.56			(27)
Windows Type 2			1.67	x1/[1/(1.4)+ 0.04]		=	2.21			(27)
Walls Type1	29.77	8.29	21.48	x	0.18	=	3.87			(29)
Walls Type2	11.99	1.98	10.01	x	0.18	=	1.8			(29)
Roof	38.74	0	38.74	x	0.13	=	5.04			(30)
Total area of elements, m²			80.5							(31)
Party wall			39.44	x	0	=	0			(32)
Party floor			53.21							(32a)
Party ceiling			14.48							(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) = 23.67 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7125.67 (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 4.03 (36)

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

Total fabric heat loss (33) + (36) = 27.7 (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

TER WorkSheet: New dwelling design stage

(38)m=	23.33	23.18	23.02	22.31	22.17	21.55	21.55	21.43	21.79	22.17	22.44	22.73	(38)

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

(39)m=	51.03	50.88	50.72	50.01	49.87	49.25	49.25	49.13	49.49	49.87	50.14	50.43	

Average = Sum(39)$_{1...12}$ /12= 50.01 (39)

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

(40)m=	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.93	0.94	0.94	0.95	

Average = Sum(40)$_{1...12}$ /12= 0.94 (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 1.78 (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 76.59 (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=	84.25	81.18	78.12	75.06	71.99	68.93	68.93	71.99	75.06	78.12	81.18	84.25	

Total = Sum(44)$_{1...12}$ = 919.05 (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=	124.94	109.27	112.76	98.3	94.32	81.39	75.42	86.55	87.58	102.07	111.42	120.99	

Total = Sum(45)$_{1...12}$ = 1205.02 (45)

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

(46)m=	18.74	16.39	16.91	14.75	14.15	12.21	11.31	12.98	13.14	15.31	16.71	18.15	(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=	42.93	37.37	39.81	37.01	36.69	33.99	35.13	36.69	37.01	39.81	40.04	42.93	(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=	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92	(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=	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92	

Output from water heater (annual)₁ ₁₂ | 1664.43 | (64)

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

(65)m=	52.27	45.67	47.44	41.94	40.53	35.56	33.86	37.95	38.38	43.89	47.06	50.96	(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=	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	(66)

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

(67)m=	14.55	12.92	10.51	7.95	5.95	5.02	5.42	7.05	9.46	12.02	14.02	14.95	(67)

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

(68)m=	155.56	157.18	153.11	144.45	133.52	123.24	116.38	114.76	118.83	127.49	138.42	148.7	(68)

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

(69)m=	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	(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=	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	(71)

Water heating gains (Table 5)

(72)m=	70.26	67.97	63.77	58.25	54.48	49.39	45.51	51.01	53.3	58.99	65.35	68.5	(72)

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

(73)m=	293.14	290.83	280.15	263.42	246.72	230.42	220.08	225.59	234.37	251.27	270.57	284.92	(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	4.95	x	11.28	x	0.63	x	0.7	=	17.07	(75)
Northeast	0.9x	0.77	x	4.95	x	22.97	x	0.63	x	0.7	=	34.74	(75)

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Northeast	0.9x	0.77	x	4.95	x	41.38	x	0.63	x	0.7	=	62.6	(75)
Northeast	0.9x	0.77	x	4.95	x	67.96	x	0.63	x	0.7	=	102.8	(75)
Northeast	0.9x	0.77	x	4.95	x	91.35	x	0.63	x	0.7	=	138.19	(75)
Northeast	0.9x	0.77	x	4.95	x	97.38	x	0.63	x	0.7	=	147.32	(75)
Northeast	0.9x	0.77	x	4.95	x	91.1	x	0.63	x	0.7	=	137.82	(75)
Northeast	0.9x	0.77	x	4.95	x	72.63	x	0.63	x	0.7	=	109.87	(75)
Northeast	0.9x	0.77	x	4.95	x	50.42	x	0.63	x	0.7	=	76.28	(75)
Northeast	0.9x	0.77	x	4.95	x	28.07	x	0.63	x	0.7	=	42.46	(75)
Northeast	0.9x	0.77	x	4.95	x	14.2	x	0.63	x	0.7	=	21.48	(75)
Northeast	0.9x	0.77	x	4.95	x	9.21	x	0.63	x	0.7	=	13.94	(75)
Northwest	0.9x	0.77	x	1.67	x	11.28	x	0.63	x	0.7	=	11.52	(81)
Northwest	0.9x	0.77	x	1.67	x	22.97	x	0.63	x	0.7	=	23.44	(81)
Northwest	0.9x	0.77	x	1.67	x	41.38	x	0.63	x	0.7	=	42.24	(81)
Northwest	0.9x	0.77	x	1.67	x	67.96	x	0.63	x	0.7	=	69.37	(81)
Northwest	0.9x	0.77	x	1.67	x	91.35	x	0.63	x	0.7	=	93.24	(81)
Northwest	0.9x	0.77	x	1.67	x	97.38	x	0.63	x	0.7	=	99.4	(81)
Northwest	0.9x	0.77	x	1.67	x	91.1	x	0.63	x	0.7	=	92.99	(81)
Northwest	0.9x	0.77	x	1.67	x	72.63	x	0.63	x	0.7	=	74.13	(81)
Northwest	0.9x	0.77	x	1.67	x	50.42	x	0.63	x	0.7	=	51.47	(81)
Northwest	0.9x	0.77	x	1.67	x	28.07	x	0.63	x	0.7	=	28.65	(81)
Northwest	0.9x	0.77	x	1.67	x	14.2	x	0.63	x	0.7	=	14.49	(81)
Northwest	0.9x	0.77	x	1.67	x	9.21	x	0.63	x	0.7	=	9.41	(81)

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

(83)m=	28.59	58.19	104.83	172.17	231.43	246.73	230.81	184	127.74	71.11	35.97	23.34	(83)

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

(84)m=	321.72	349.02	384.99	435.59	478.14	477.15	450.89	409.6	362.11	322.38	306.54	308.26	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.84	0.64	0.48	0.54	0.83	0.98	1	1	(86)

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

(87)m=	20.03	20.14	20.35	20.65	20.89	20.98	21	20.99	20.93	20.63	20.28	20.01	(87)

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

(88)m=	20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13	(88)

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

(89)m=	1	0.99	0.99	0.94	0.8	0.56	0.39	0.45	0.76	0.97	0.99	1	(89)

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

(90)m=	18.81	18.98	19.29	19.72	20.03	20.13	20.14	20.15	20.08	19.69	19.19	18.8	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	19.34	19.48	19.75	20.13	20.4	20.5	20.52	20.51	20.45	20.1	19.67	19.32	(92)

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

(93)m=	19.34	19.48	19.75	20.13	20.4	20.5	20.52	20.51	20.45	20.1	19.67	19.32	(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=	1	0.99	0.98	0.94	0.81	0.6	0.43	0.49	0.79	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	320.54	346.75	378.55	409.38	387.93	284.71	192.14	200.67	285.85	311.13	304.3	307.37	(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=	767.65	741.8	672.05	561.47	433.97	290.7	192.81	202.14	314.14	473.73	630.14	762.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	332.65	265.48	218.36	109.5	34.25	0	0	0	0	120.97	234.6	338.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1654.58 (98)

Space heating requirement in kWh/m²/year 31.1 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		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)													
	332.65	265.48	218.36	109.5	34.25	0	0	0	0	120.97	234.6	338.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	356.16	284.24	233.79	117.24	36.67	0	0	0	0	129.52	251.18	362.7	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1771.5 (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)

	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92	
Efficiency of water heater												80.3	(216)
(217)m=	86.74	86.53	85.95	84.52	82.2	80.3	80.3	80.3	80.3	84.65	86.15	86.84	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	193.53	169.47	177.5	160.09	159.37	143.7	137.67	153.47	155.17	167.6	175.8	188.77

Total = Sum(219a)$_{1...12}$ = 1982.14 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1771.5	
Water heating fuel used			1982.14	
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			256.89	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	382.64	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	428.14	(264)
Space and water heating	(261) + (262) + (263) + (264) =			810.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	133.32	(268)
Total CO2, kg/year		sum of (265)…(271) =		983.03	(272)

TER = 18.47 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 07-Lean

Address : Flat 07, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground floor	63.73	(1a) x	2.2	(2a) =	140.21	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.73	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	140.21	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m^3 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) =	0.14	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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

0.46	0.45	0.44	0.4	0.39	0.35	0.35	0.34	0.36	0.39	0.41	0.43

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=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1	=	1.98			(26)
Windows Type 1			3.4	x1/[1/(1.4)+ 0.04]		=	4.51			(27)
Windows Type 2			1.8	x1/[1/(1.4)+ 0.04]		=	2.39			(27)
Windows Type 3			2.07	x1/[1/(1.4)+ 0.04]		=	2.74			(27)
Walls Type1	51.69	10.87	40.82	x	0.18	=	7.35			(29)
Walls Type2	9.19	1.98	7.21	x	0.18	=	1.3			(29)
Roof	63.73	0	63.73	x	0.13	=	8.28			(30)
Total area of elements, m²			124.61							(31)
Party wall			28.69	x	0	=	0			(32)
Party floor			63.73							(32a)
Party ceiling			14.48							(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) = 33.32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8126.04 (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 6.23 (36)

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

Total fabric heat loss (33) + (36) = 39.55 (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=	28.09	27.9	27.71	26.83	26.66	25.89	25.89	25.75	26.19	26.66	27	27.35	(38)

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

(39)m=	67.65	67.45	67.27	66.38	66.21	65.44	65.44	65.3	65.74	66.21	66.55	66.9	

Average = Sum(39)$_{1...12}$ /12= 66.38 (39)

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

(40)m=	1.06	1.06	1.06	1.04	1.04	1.03	1.03	1.02	1.03	1.04	1.04	1.05	

Average = Sum(40)$_{1...12}$ /12= 1.04 (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 2.08 (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 83.72 (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=	92.09	88.74	85.39	82.04	78.69	75.34	75.34	78.69	82.04	85.39	88.74	92.09	

Total = Sum(44)$_{1...12}$ = 1004.6 (44)

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

(45)m=	136.56	119.44	123.25	107.45	103.1	88.97	82.44	94.61	95.74	111.57	121.79	132.25	

Total = Sum(45)$_{1...12}$ = 1317.18 (45)

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

(46)m=	20.48	17.92	18.49	16.12	15.47	13.35	12.37	14.19	14.36	16.74	18.27	19.84	(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=	46.93	40.84	43.51	40.46	40.1	37.16	38.39	40.1	40.46	43.51	43.76	46.93	(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=	183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18	(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=	183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18

Output from water heater (annual)₁ ₁₂ — 1819.34 (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=	57.14	49.92	51.86	45.84	44.31	38.87	37.01	41.48	41.95	47.98	51.44	55.71	(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=	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	(66)

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

(67)m=	16.75	14.87	12.1	9.16	6.85	5.78	6.24	8.12	10.9	13.83	16.15	17.21	(67)

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

(68)m=	182.25	184.14	179.37	169.23	156.42	144.38	136.34	134.45	139.22	149.36	162.17	174.21	(68)

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

(69)m=	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	(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=	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	(71)

Water heating gains (Table 5)

(72)m=	76.8	74.29	69.7	63.67	59.55	53.99	49.75	55.76	58.26	64.48	71.44	74.87	(72)

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

(73)m=	333.07	330.58	318.45	299.33	280.09	261.42	249.61	255.6	265.64	284.95	307.03	323.57	(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	3.4	x	11.28	x	0.63	x	0.7	=	11.72	(75)
Northeast	0.9x	0.77	x	3.4	x	22.97	x	0.63	x	0.7	=	23.86	(75)
Northeast	0.9x	0.77	x	3.4	x	41.38	x	0.63	x	0.7	=	43	(75)
Northeast	0.9x	0.77	x	3.4	x	67.96	x	0.63	x	0.7	=	70.61	(75)
Northeast	0.9x	0.77	x	3.4	x	91.35	x	0.63	x	0.7	=	94.92	(75)
Northeast	0.9x	0.77	x	3.4	x	97.38	x	0.63	x	0.7	=	101.19	(75)
Northeast	0.9x	0.77	x	3.4	x	91.1	x	0.63	x	0.7	=	94.66	(75)
Northeast	0.9x	0.77	x	3.4	x	72.63	x	0.63	x	0.7	=	75.47	(75)
Northeast	0.9x	0.77	x	3.4	x	50.42	x	0.63	x	0.7	=	52.39	(75)
Northeast	0.9x	0.77	x	3.4	x	28.07	x	0.63	x	0.7	=	29.16	(75)
Northeast	0.9x	0.77	x	3.4	x	14.2	x	0.63	x	0.7	=	14.75	(75)
Northeast	0.9x	0.77	x	3.4	x	9.21	x	0.63	x	0.7	=	9.57	(75)
Northwest	0.9x	0.77	x	1.8	x	11.28	x	0.63	x	0.7	=	18.62	(81)
Northwest	0.9x	0.77	x	2.07	x	11.28	x	0.63	x	0.7	=	7.14	(81)
Northwest	0.9x	0.77	x	1.8	x	22.97	x	0.63	x	0.7	=	37.9	(81)
Northwest	0.9x	0.77	x	2.07	x	22.97	x	0.63	x	0.7	=	14.53	(81)
Northwest	0.9x	0.77	x	1.8	x	41.38	x	0.63	x	0.7	=	68.29	(81)
Northwest	0.9x	0.77	x	2.07	x	41.38	x	0.63	x	0.7	=	26.18	(81)
Northwest	0.9x	0.77	x	1.8	x	67.96	x	0.63	x	0.7	=	112.15	(81)
Northwest	0.9x	0.77	x	2.07	x	67.96	x	0.63	x	0.7	=	42.99	(81)
Northwest	0.9x	0.77	x	1.8	x	91.35	x	0.63	x	0.7	=	150.75	(81)
Northwest	0.9x	0.77	x	2.07	x	91.35	x	0.63	x	0.7	=	57.79	(81)
Northwest	0.9x	0.77	x	1.8	x	97.38	x	0.63	x	0.7	=	160.71	(81)
Northwest	0.9x	0.77	x	2.07	x	97.38	x	0.63	x	0.7	=	61.61	(81)
Northwest	0.9x	0.77	x	1.8	x	91.1	x	0.63	x	0.7	=	150.35	(81)
Northwest	0.9x	0.77	x	2.07	x	91.1	x	0.63	x	0.7	=	57.63	(81)
Northwest	0.9x	0.77	x	1.8	x	72.63	x	0.63	x	0.7	=	119.86	(81)
Northwest	0.9x	0.77	x	2.07	x	72.63	x	0.63	x	0.7	=	45.95	(81)
Northwest	0.9x	0.77	x	1.8	x	50.42	x	0.63	x	0.7	=	83.21	(81)
Northwest	0.9x	0.77	x	2.07	x	50.42	x	0.63	x	0.7	=	31.9	(81)
Northwest	0.9x	0.77	x	1.8	x	28.07	x	0.63	x	0.7	=	46.32	(81)
Northwest	0.9x	0.77	x	2.07	x	28.07	x	0.63	x	0.7	=	17.76	(81)
Northwest	0.9x	0.77	x	1.8	x	14.2	x	0.63	x	0.7	=	23.43	(81)
Northwest	0.9x	0.77	x	2.07	x	14.2	x	0.63	x	0.7	=	8.98	(81)
Northwest	0.9x	0.77	x	1.8	x	9.21	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	2.07	x	9.21	x	0.63	x	0.7	=	5.83	(81)

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

(83)m=	37.48	76.3	137.46	225.75	303.45	323.51	302.64	241.27	167.5	93.24	47.16	30.61	(83)

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

(84)m=	370.55	406.87	455.91	525.08	583.54	584.94	552.25	496.86	433.14	378.19	354.19	354.18	(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	1	0.99	0.96	0.87	0.68	0.51	0.59	0.86	0.98	1	1		(86)

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

(87)m=	19.86	19.98	20.22	20.55	20.83	20.97	20.99	20.99	20.88	20.52	20.14	19.84		(87)

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

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

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

(89)m=	1	1	0.99	0.95	0.82	0.59	0.41	0.48	0.8	0.97	1	1		(89)

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

(90)m=	18.51	18.68	19.03	19.52	19.89	20.04	20.06	20.06	19.96	19.48	18.93	18.49		(90)
										fLA = Living area ÷ (4) =			0.47	(91)

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

(92)m=	19.14	19.29	19.58	20	20.33	20.48	20.5	20.49	20.39	19.97	19.5	19.13		(92)

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

(93)m=	19.14	19.29	19.58	20	20.33	20.48	20.5	20.49	20.39	19.97	19.5	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=	1	0.99	0.99	0.95	0.84	0.63	0.46	0.53	0.83	0.97	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	369.43	404.66	449.45	498.23	487.98	370.52	253.12	263.26	357.63	367.86	352.14	353.34		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1004.15	970.81	880.13	737.04	571.61	384.49	255.08	267.38	413.57	620.52	824.95	998.49		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	472.23	380.45	320.43	171.94	62.22	0	0	0	0	187.98	340.43	479.99		
									Total per year (kWh/year) = Sum(98)1...5,9...12 =				2415.67	(98)
Space heating requirement in kWh/m²/year													37.9	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		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)														
	472.23	380.45	320.43	171.94	62.22	0	0	0	0	187.98	340.43	479.99		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	505.6	407.34	343.07	184.09	66.61	0	0	0	0	201.26	364.48	513.91		
									Total (kWh/year) =Sum(211)1...5,10...12=				2586.37	(211)

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

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

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

Water heating

Output from water heater (calculated above)

183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18

Efficiency of water heater 80.3 (216)

(217)m=	87.33	87.15	86.67	85.43	83.11	80.3	80.3	80.3	80.3	85.54	86.83	87.41	(217)

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

(219)m=	210.12	183.92	192.42	173.14	172.3	157.07	150.48	167.76	169.61	181.31	190.67	204.99

Total = Sum(219a)$_{1...12}$ = 2153.77 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2586.37	
Water heating fuel used		2153.77	
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		295.76	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	558.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	465.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1023.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	153.5	(268)
Total CO2, kg/year		sum of (265) (271) =		1216.29	(272)

TER = 19.09 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 08-Lean

Address : Flat 08, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	7.67	(1a)	x	2.5	(2a)	=	19.18	(3a)
First floor	138.42	(1b)	x	2.5	(2b)	=	346.05	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	146.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	365.22	(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) =	0.11	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

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=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.61	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1	=	1.98			(26)
Windows Type 1			1.45	x1/[1/(1.4)+ 0.04]		=	1.92			(27)
Windows Type 2			3.21	x1/[1/(1.4)+ 0.04]		=	4.26			(27)
Windows Type 3			1.56	x1/[1/(1.4)+ 0.04]		=	2.07			(27)
Rooflights Type 1			1.38	x1/[1/(1.7) + 0.04]		=	2.346			(27b)
Rooflights Type 2			1.32	x1/[1/(1.7) + 0.04]		=	2.244			(27b)
Floor			16.84	x	0.13	=	2.1892			(28)
Walls Type1	58.24	3.12	55.12	x	0.18	=	9.92			(29)
Walls Type2	30.56	1.98	28.58	x	0.18	=	5.14			(29)
Walls Type3	63.68	0	63.68	x	0.18	=	11.46			(29)
Walls Type4	21.95	16.57	5.38	x	0.18	=	0.97			(29)
Roof Type1	110.25	2.7	107.55	x	0.13	=	13.98			(30)
Roof Type2	6.05	0	6.05	x	0.13	=	0.79			(30)
Total area of elements, m²			307.57							(31)
Party wall			19.63	x	0	=	0			(32)
Party floor			121.58							(32a)
Party ceiling			14.48							(32b)

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** 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) =	76.84	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	15227.24	(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		15.38	(36)

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

Total fabric heat loss	(33) + (36) =	92.21	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	72.92	72.43	71.95	69.69	69.26	67.29	67.29	66.93	68.05	69.26	70.12	71.02	(38)

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

(39)m=	165.14	164.65	164.17	161.9	161.48	159.51	159.51	159.14	160.27	161.48	162.33	163.23	

Average = $Sum(39)_{1...12}$ /12= 161.9 (39)

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

(40)m=	1.13	1.13	1.12	1.11	1.11	1.09	1.09	1.09	1.1	1.11	1.11	1.12	

Average = $Sum(40)_{1...12}$ /12= 1.11 (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 — 2.93 (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 — 103.74 (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=	114.11	109.96	105.81	101.66	97.51	93.36	93.36	97.51	101.66	105.81	109.96	114.11

Total = $Sum(44)_{1...12}$ = 1244.85 (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=	169.22	148	152.73	133.15	127.76	110.25	102.16	117.23	118.63	138.25	150.92	163.88

Total = $Sum(45)_{1...12}$ = 1632.19 (45)

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

(46)m=	25.38	22.2	22.91	19.97	19.16	16.54	15.32	17.58	17.79	20.74	22.64	24.58	(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)

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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	49.69	46.04	47.58	49.69	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=	220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84	(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=	220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84

Output from water heater (annual)1…12 | 2223.01 | (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=	69.01	60.72	63.52	56.6	54.9	48.17	45.86	51.4	51.77	58.71	62.51	67.23	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	(66)

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

(67)m=	29.52	26.22	21.32	16.14	12.07	10.19	11.01	14.31	19.21	24.39	28.46	30.34	(67)

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

(68)m=	316.24	319.52	311.25	293.64	271.42	250.54	236.58	233.3	241.57	259.17	281.4	302.28	(68)

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

(69)m=	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	(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=	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	(71)

Water heating gains (Table 5)

(72)m=	92.75	90.35	85.38	78.61	73.8	66.9	61.64	69.09	71.91	78.91	86.82	90.36	(72)

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

(73)m=	508.43	506.01	487.87	458.32	427.2	397.54	379.15	386.62	402.6	432.39	466.6	492.91	(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	1.56	x	11.28	x	0.63	x	0.7	=	10.76	(75)
Northeast 0.9x	0.77	x	1.56	x	22.97	x	0.63	x	0.7	=	21.9	(75)
Northeast 0.9x	0.77	x	1.56	x	41.38	x	0.63	x	0.7	=	39.46	(75)
Northeast 0.9x	0.77	x	1.56	x	67.96	x	0.63	x	0.7	=	64.8	(75)
Northeast 0.9x	0.77	x	1.56	x	91.35	x	0.63	x	0.7	=	87.1	(75)
Northeast 0.9x	0.77	x	1.56	x	97.38	x	0.63	x	0.7	=	92.86	(75)
Northeast 0.9x	0.77	x	1.56	x	91.1	x	0.63	x	0.7	=	86.87	(75)
Northeast 0.9x	0.77	x	1.56	x	72.63	x	0.63	x	0.7	=	69.25	(75)
Northeast 0.9x	0.77	x	1.56	x	50.42	x	0.63	x	0.7	=	48.08	(75)
Northeast 0.9x	0.77	x	1.56	x	28.07	x	0.63	x	0.7	=	26.76	(75)
Northeast 0.9x	0.77	x	1.56	x	14.2	x	0.63	x	0.7	=	13.54	(75)
Northeast 0.9x	0.77	x	1.56	x	9.21	x	0.63	x	0.7	=	8.79	(75)
Southeast 0.9x	0.77	x	1.45	x	36.79	x	0.63	x	0.7	=	114.13	(77)
Southeast 0.9x	0.77	x	1.45	x	62.67	x	0.63	x	0.7	=	194.41	(77)
Southeast 0.9x	0.77	x	1.45	x	85.75	x	0.63	x	0.7	=	266	(77)
Southeast 0.9x	0.77	x	1.45	x	106.25	x	0.63	x	0.7	=	329.59	(77)
Southeast 0.9x	0.77	x	1.45	x	119.01	x	0.63	x	0.7	=	369.17	(77)
Southeast 0.9x	0.77	x	1.45	x	118.15	x	0.63	x	0.7	=	366.5	(77)
Southeast 0.9x	0.77	x	1.45	x	113.91	x	0.63	x	0.7	=	353.34	(77)
Southeast 0.9x	0.77	x	1.45	x	104.39	x	0.63	x	0.7	=	323.82	(77)
Southeast 0.9x	0.77	x	1.45	x	92.85	x	0.63	x	0.7	=	288.02	(77)
Southeast 0.9x	0.77	x	1.45	x	69.27	x	0.63	x	0.7	=	214.87	(77)
Southeast 0.9x	0.77	x	1.45	x	44.07	x	0.63	x	0.7	=	136.71	(77)
Southeast 0.9x	0.77	x	1.45	x	31.49	x	0.63	x	0.7	=	97.67	(77)
Northwest 0.9x	0.77	x	3.21	x	11.28	x	0.63	x	0.7	=	22.14	(81)
Northwest 0.9x	0.77	x	3.21	x	22.97	x	0.63	x	0.7	=	45.06	(81)
Northwest 0.9x	0.77	x	3.21	x	41.38	x	0.63	x	0.7	=	81.19	(81)
Northwest 0.9x	0.77	x	3.21	x	67.96	x	0.63	x	0.7	=	133.33	(81)
Northwest 0.9x	0.77	x	3.21	x	91.35	x	0.63	x	0.7	=	179.22	(81)
Northwest 0.9x	0.77	x	3.21	x	97.38	x	0.63	x	0.7	=	191.07	(81)
Northwest 0.9x	0.77	x	3.21	x	91.1	x	0.63	x	0.7	=	178.74	(81)
Northwest 0.9x	0.77	x	3.21	x	72.63	x	0.63	x	0.7	=	142.5	(81)

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Northwest 0.9x	0.77	x	3.21	x	50.42	x	0.63	x	0.7	=	98.93	(81)
Northwest 0.9x	0.77	x	3.21	x	28.07	x	0.63	x	0.7	=	55.07	(81)
Northwest 0.9x	0.77	x	3.21	x	14.2	x	0.63	x	0.7	=	27.85	(81)
Northwest 0.9x	0.77	x	3.21	x	9.21	x	0.63	x	0.7	=	18.08	(81)
Rooflights 0.9x	1	x	1.38	x	26	x	0.63	x	0.7	=	14.24	(82)
Rooflights 0.9x	1	x	1.32	x	26	x	0.63	x	0.7	=	13.62	(82)
Rooflights 0.9x	1	x	1.38	x	54	x	0.63	x	0.7	=	29.58	(82)
Rooflights 0.9x	1	x	1.32	x	54	x	0.63	x	0.7	=	28.29	(82)
Rooflights 0.9x	1	x	1.38	x	96	x	0.63	x	0.7	=	52.58	(82)
Rooflights 0.9x	1	x	1.32	x	96	x	0.63	x	0.7	=	50.3	(82)
Rooflights 0.9x	1	x	1.38	x	150	x	0.63	x	0.7	=	82.16	(82)
Rooflights 0.9x	1	x	1.32	x	150	x	0.63	x	0.7	=	78.59	(82)
Rooflights 0.9x	1	x	1.38	x	192	x	0.63	x	0.7	=	105.16	(82)
Rooflights 0.9x	1	x	1.32	x	192	x	0.63	x	0.7	=	100.59	(82)
Rooflights 0.9x	1	x	1.38	x	200	x	0.63	x	0.7	=	109.54	(82)
Rooflights 0.9x	1	x	1.32	x	200	x	0.63	x	0.7	=	104.78	(82)
Rooflights 0.9x	1	x	1.38	x	189	x	0.63	x	0.7	=	103.52	(82)
Rooflights 0.9x	1	x	1.32	x	189	x	0.63	x	0.7	=	99.02	(82)
Rooflights 0.9x	1	x	1.38	x	157	x	0.63	x	0.7	=	85.99	(82)
Rooflights 0.9x	1	x	1.32	x	157	x	0.63	x	0.7	=	82.25	(82)
Rooflights 0.9x	1	x	1.38	x	115	x	0.63	x	0.7	=	62.99	(82)
Rooflights 0.9x	1	x	1.32	x	115	x	0.63	x	0.7	=	60.25	(82)
Rooflights 0.9x	1	x	1.38	x	66	x	0.63	x	0.7	=	36.15	(82)
Rooflights 0.9x	1	x	1.32	x	66	x	0.63	x	0.7	=	34.58	(82)
Rooflights 0.9x	1	x	1.38	x	33	x	0.63	x	0.7	=	18.07	(82)
Rooflights 0.9x	1	x	1.32	x	33	x	0.63	x	0.7	=	17.29	(82)
Rooflights 0.9x	1	x	1.38	x	21	x	0.63	x	0.7	=	11.5	(82)
Rooflights 0.9x	1	x	1.32	x	21	x	0.63	x	0.7	=	11	(82)

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

(83)m=	174.89	319.24	489.52	688.46	841.24	864.75	821.49	703.81	558.27	367.42	213.46	147.04	(83)

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

(84)m=	683.32	825.25	977.39	1146.78	1268.45	1262.3	1200.64	1090.43	960.87	799.81	680.06	639.95	(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	0.97	0.9	0.74	0.57	0.64	0.89	0.99	1	1	(86)

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

(87)m=	19.66	19.82	20.09	20.45	20.77	20.94	20.99	20.98	20.84	20.42	19.98	19.64	(87)

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

(88)m=	19.98	19.98	19.98	19.99	20	20.01	20.01	20.01	20	20	19.99	19.99	(88)

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

(89)m=	1	1	0.99	0.96	0.86	0.65	0.45	0.52	0.83	0.98	1	1	(89)

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

(90)m=	18.18	18.41	18.8	19.34	19.76	19.97	20	20	19.86	19.3	18.65	18.15	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	18.73	18.94	19.29	19.76	20.14	20.34	20.37	20.37	20.23	19.72	19.15	18.71	(92)

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

(93)m=	18.73	18.94	19.29	19.76	20.14	20.34	20.37	20.37	20.23	19.72	19.15	18.71	(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	0.96	0.87	0.68	0.49	0.56	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	682.48	822.49	966.87	1099.75	1099.63	861.01	593.78	615.95	815.26	784.1	678.16	639.39	(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=	2383.68	2311.76	2099.37	1757.81	1362.77	914.82	601.94	631.58	982.59	1473.39	1956.22	2368.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1265.69	1000.79	842.58	473.8	195.78	0	0	0	0	512.83	920.2	1286.67	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6498.34 (98)

Space heating requirement in kWh/m²/year 44.48 (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)													
	1265.69	1000.79	842.58	473.8	195.78	0	0	0	0	512.83	920.2	1286.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1355.13	1071.51	902.12	507.28	209.61	0	0	0	0	549.07	985.23	1377.59	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 6957.54 (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)

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Water heating

Output from water heater (calculated above)

	220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84		
Efficiency of water heater													80.3	(216)
(217)m=	88.75	88.59	88.24	87.35	85.3	80.3	80.3	80.3	80.3	87.44	88.41	88.8		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	248.1	219.02	230.83	208.9	208.04	194.63	186.47	207.87	209.15	216.4	226.47	241.94		
								Total = Sum(219a)$_{1...12}$ =					2597.84	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6957.54	
Water heating fuel used			2597.84	
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			521.37	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1502.83	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	561.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2063.96	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	270.59	(268)
Total CO2, kg/year		sum of (265) (271) =		2373.48	(272)

TER = 16.25 (273)

Appendix B
Energy Assessment
51 Calthorpe Street

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Be Lean Residential – DER from the Be Lean scenario DER SAP worksheet

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 01-Lean

Address : Flat 01, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.6	(1a) x	2.7	(2a) =	193.32	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	193.32	(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) =	0.34	(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

DER WorkSheet: New dwelling design stage

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	0.34	0.37	0.39	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=	0.6	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			3	x	1.6	=	4.8			(26)
Windows Type 1			2.36	x1/[1/(1.6)+ 0.04]		=	3.55			(27)
Windows Type 2			1.93	x1/[1/(1.6)+ 0.04]		=	2.9			(27)
Windows Type 3			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Floor			71.6	x	0.12	=	8.592			(28)
Walls Type1	52.87	13.38	39.49	x	0.23	=	9.08			(29)
Walls Type2	32.34	0	32.34	x	0.12	=	3.74			(29)
Total area of elements, m²			156.81							(31)
Party wall			20.9	x	0	=	0			(32)
Party ceiling			71.6							(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) = 41.83 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16100.47 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 23.52 (36)

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

Total fabric heat loss (33) + (36) = 65.35 (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=	38.05	37.81	37.58	36.48	36.27	35.31	35.31	35.14	35.68	36.27	36.69	37.12	(38)

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

(39)m=	103.4	103.16	102.92	101.82	101.62	100.66	100.66	100.48	101.03	101.62	102.03	102.47	

Average = Sum(39)$_{1\ldots12}$ /12= 101.82 (39)

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

(40)m=	1.44	1.44	1.44	1.42	1.42	1.41	1.41	1.4	1.41	1.42	1.43	1.43

Average = Sum(40)$_{1\ldots12}$ /12= 1.42 (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 2.28 (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 88.45 (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=	97.3	93.76	90.22	86.68	83.15	79.61	79.61	83.15	86.68	90.22	93.76	97.3

Total = Sum(44)$_{1\ldots12}$ = 1061.44 (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=	144.29	126.2	130.22	113.53	108.94	94	87.11	99.96	101.15	117.88	128.68	139.74

Total = Sum(45)$_{1\ldots12}$ = 1391.71 (45)

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

(46)m=	21.64	18.93	19.53	17.03	16.34	14.1	13.07	14.99	15.17	17.68	19.3	20.96	(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=	49.58	43.16	45.98	42.75	42.37	39.26	40.57	42.37	42.75	45.98	46.24	49.58	(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=	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32	(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=	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32

Output from water heater (annual)₁ ₁₂ | 1922.28 | (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=	60.37	52.75	54.79	48.44	46.81	41.07	39.11	43.83	44.32	50.69	54.35	58.86	(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=	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.08	16.95	13.78	10.43	7.8	6.58	7.11	9.25	12.41	15.76	18.4	19.61	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	201	203.09	197.83	186.64	172.52	159.24	150.37	148.29	153.54	164.73	178.86	192.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	(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=	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	(71)
Water heating gains (Table 5)													
(72)m=	81.15	78.5	73.65	67.27	62.92	57.04	52.56	58.91	61.56	68.13	75.48	79.11	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	361.49	358.8	345.53	324.61	303.5	283.14	270.31	276.71	287.78	308.89	333	351.12	(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)	
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	53.07	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	90.41	(77)

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Southeast 0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	123.7	(77)
Southeast 0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	153.27	(77)
Southeast 0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	171.67	(77)
Southeast 0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	170.43	(77)
Southeast 0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	164.31	(77)
Southeast 0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	150.58	(77)
Southeast 0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	133.94	(77)
Southeast 0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	99.92	(77)
Southeast 0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	63.57	(77)
Southeast 0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	45.42	(77)
Southwest 0.9x	0.77	x	1.8	x	36.79		0.63	x	0.7	=	20.24	(79)
Southwest 0.9x	0.77	x	1.8	x	62.67		0.63	x	0.7	=	34.48	(79)
Southwest 0.9x	0.77	x	1.8	x	85.75		0.63	x	0.7	=	47.17	(79)
Southwest 0.9x	0.77	x	1.8	x	106.25		0.63	x	0.7	=	58.45	(79)
Southwest 0.9x	0.77	x	1.8	x	119.01		0.63	x	0.7	=	65.47	(79)
Southwest 0.9x	0.77	x	1.8	x	118.15		0.63	x	0.7	=	64.99	(79)
Southwest 0.9x	0.77	x	1.8	x	113.91		0.63	x	0.7	=	62.66	(79)
Southwest 0.9x	0.77	x	1.8	x	104.39		0.63	x	0.7	=	57.43	(79)
Southwest 0.9x	0.77	x	1.8	x	92.85		0.63	x	0.7	=	51.08	(79)
Southwest 0.9x	0.77	x	1.8	x	69.27		0.63	x	0.7	=	38.1	(79)
Southwest 0.9x	0.77	x	1.8	x	44.07		0.63	x	0.7	=	24.24	(79)
Southwest 0.9x	0.77	x	1.8	x	31.49		0.63	x	0.7	=	17.32	(79)
Northwest 0.9x	0.77	x	1.93	x	11.28	x	0.63	x	0.7	=	13.31	(81)
Northwest 0.9x	0.77	x	1.93	x	22.97	x	0.63	x	0.7	=	27.09	(81)
Northwest 0.9x	0.77	x	1.93	x	41.38	x	0.63	x	0.7	=	48.81	(81)
Northwest 0.9x	0.77	x	1.93	x	67.96	x	0.63	x	0.7	=	80.17	(81)
Northwest 0.9x	0.77	x	1.93	x	91.35	x	0.63	x	0.7	=	107.76	(81)
Northwest 0.9x	0.77	x	1.93	x	97.38	x	0.63	x	0.7	=	114.88	(81)
Northwest 0.9x	0.77	x	1.93	x	91.1	x	0.63	x	0.7	=	107.47	(81)
Northwest 0.9x	0.77	x	1.93	x	72.63	x	0.63	x	0.7	=	85.68	(81)
Northwest 0.9x	0.77	x	1.93	x	50.42	x	0.63	x	0.7	=	59.48	(81)
Northwest 0.9x	0.77	x	1.93	x	28.07	x	0.63	x	0.7	=	33.11	(81)
Northwest 0.9x	0.77	x	1.93	x	14.2	x	0.63	x	0.7	=	16.75	(81)
Northwest 0.9x	0.77	x	1.93	x	9.21	x	0.63	x	0.7	=	10.87	(81)

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

(83)m=	86.63	151.98	219.68	291.88	344.9	350.31	334.44	293.68	244.5	171.13	104.56	73.61	(83)

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

(84)m=	448.12	510.77	565.21	616.5	648.4	633.44	604.76	570.39	532.27	480.02	437.56	424.73	(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	1	0.99	0.97	0.93	0.82	0.67	0.72	0.9	0.98	1	1	(86)

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

(87)m=	19.41	19.56	19.84	20.21	20.57	20.84	20.95	20.93	20.73	20.27	19.77	19.38	(87)

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

(88)m=	19.73	19.73	19.73	19.75	19.75	19.76	19.76	19.76	19.75	19.75	19.74	19.74	(88)

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

(89)m=	1	0.99	0.99	0.96	0.89	0.72	0.51	0.56	0.84	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=	17.63	17.87	18.26	18.81	19.31	19.65	19.74	19.73	19.53	18.9	18.18	17.6	(90)

fLA = Living area ÷ (4) = 0.32 (91)

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

(92)m=	18.21	18.42	18.78	19.26	19.72	20.03	20.13	20.12	19.92	19.34	18.7	18.18	(92)

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

(93)m=	18.21	18.42	18.78	19.26	19.72	20.03	20.13	20.12	19.92	19.34	18.7	18.18	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.75	0.56	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	445.83	506.04	554.57	588.83	576.89	473.4	339.77	350.56	451.6	463.37	433.51	422.99	(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=	1438.28	1394.47	1263.44	1055.34	814.8	547.06	355.74	374.06	587.59	888.49	1183.25	1432.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	738.39	597.02	527.4	335.89	177	0	0	0	0	316.29	539.81	751.15	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3982.94 (98)

Space heating requirement in kWh/m²/year 55.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	738.39	597.02	527.4	335.89	177	0	0	0	0	316.29	539.81	751.15	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	817.7	661.15	584.05	371.97	196.02	0	0	0	0	350.26	597.79	831.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4410.79 (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)

	193.87	169.35	176.2	156.28	151.31	133.26	127.68	142.33	143.9	163.86	174.92	189.32		
Efficiency of water heater													81	(216)
(217)m=	88.19	88.07	87.78	87.12	85.76	81	81	81	81	86.9	87.83	88.26		(217)

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

(219)m=	219.82	192.3	200.74	179.38	176.43	164.52	157.63	175.72	177.66	188.57	199.15	214.5		
								Total = Sum(219a)$_{1...12}$ =					2246.41	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4410.79	
Water heating fuel used			2246.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			336.96	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	952.73	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	485.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1437.96	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	174.88	(268)
Total CO2, kg/year		sum of (265)…(271) =		1628.41	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		22.74	(273)
EI rating (section 14)				81	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 02-Lean

Address : Flat 02, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	68.42	(1a) x	3.13	(2a) =	214.15	(3a)
First floor	29.89	(1b) x	2.2	(2b) =	65.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.31	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		279.91	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.11	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(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) =	0.3	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.39	0.38	0.37	0.33	0.33	0.29	0.29	0.28	0.3	0.33	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

(25)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1.4	=	2.772			(26)
Windows Type 1			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 2			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 3			2.55	x1/[1/(1.6)+ 0.04]		=	3.83			(27)
Windows Type 4			2.34	x1/[1/(1.6)+ 0.04]		=	3.52			(27)
Windows Type 5			0.81	x1/[1/(1.6)+ 0.04]		=	1.22			(27)
Windows Type 6			0.74	x1/[1/(1.6)+ 0.04]		=	1.11			(27)
Windows Type 7			2.49	x1/[1/(1.6)+ 0.04]		=	3.74			(27)
Floor			18.51	x	0.12	=	2.2212			(28)
Walls Type1	60.8	13.01	47.79	x	0.23	=	10.99			(29)
Walls Type2	29.23	1.98	27.25	x	0.12	=	3.15			(29)
Walls Type3	2.83	0	2.83	x	0.12	=	0.34			(29)
Roof	20.68	0	20.68	x	0.1	=	2.07			(30)
Total area of elements, m²			132.05							(31)
Party wall			92.15	x	0	=	0			(32)
Party floor			49.91							(32a)
Party ceiling			47.74							(32b)

DER WorkSheet: New dwelling design stage

** 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) =	41.11	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	13532.85	(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		19.81	(36)

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

Total fabric heat loss	(33) + (36) =	60.92	(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=	53.11	52.84	52.57	51.34	51.11	50.03	50.03	49.83	50.44	51.11	51.57	52.06	(38)

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

(39)m=	114.02	113.75	113.49	112.25	112.02	110.94	110.94	110.74	111.36	112.02	112.49	112.98	

Average = $Sum(39)_{1...12}$ /12= 112.25 (39)

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

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

Average = $Sum(40)_{1...12}$ /12= 1.14 (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 — 2.72 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 98.88 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	108.77	104.81	100.86	96.9	92.95	88.99	88.99	92.95	96.9	100.86	104.81	108.77	

Total = $Sum(44)_{1...12}$ = 1186.55 (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=	161.3	141.07	145.57	126.91	121.78	105.08	97.38	111.74	113.08	131.78	143.85	156.21	

Total = $Sum(45)_{1...12}$ = 1555.75 (45)

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

(46)m=	24.19	21.16	21.84	19.04	18.27	15.76	14.61	16.76	16.96	19.77	21.58	23.43	(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)

DER WorkSheet: New dwelling design stage

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	47.79	47.36	43.89	45.35	47.36	47.79	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=	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17	(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=	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17

Output from water heater (annual)$_{1\ \ 12}$ — 2134.46 (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=	66.37	58.41	61.14	54.15	52.33	45.91	43.71	49	49.54	56.56	60.16	64.68	(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=	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	(66)

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

(67)m=	24.55	21.81	17.74	13.43	10.04	8.47	9.16	11.9	15.97	20.28	23.67	25.24	(67)

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

(68)m=	253.57	256.2	249.57	235.45	217.63	200.89	189.7	187.07	193.7	207.81	225.63	242.38	(68)

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

(69)m=	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	(71)

Water heating gains (Table 5)

(72)m=	89.21	86.92	82.18	75.2	70.34	63.77	58.76	65.85	68.81	76.02	83.55	86.93	(72)

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

(73)m=	434.18	431.78	416.33	390.93	364.86	339.98	324.46	331.67	345.33	370.96	399.71	421.4	(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)	
Southeast 0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast 0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast 0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast 0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast 0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast 0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast 0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast 0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast 0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast 0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast 0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast 0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast 0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast 0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast 0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast 0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast 0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast 0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast 0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast 0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast 0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast 0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast 0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Southeast 0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southwest 0.9x	0.77	x	2.49	x	36.79		0.63	x	0.7	=	28	(79)
Southwest 0.9x	0.77	x	2.49	x	62.67		0.63	x	0.7	=	47.69	(79)
Southwest 0.9x	0.77	x	2.49	x	85.75		0.63	x	0.7	=	65.26	(79)
Southwest 0.9x	0.77	x	2.49	x	106.25		0.63	x	0.7	=	80.85	(79)
Southwest 0.9x	0.77	x	2.49	x	119.01		0.63	x	0.7	=	90.56	(79)
Southwest 0.9x	0.77	x	2.49	x	118.15		0.63	x	0.7	=	89.91	(79)
Southwest 0.9x	0.77	x	2.49	x	113.91		0.63	x	0.7	=	86.68	(79)
Southwest 0.9x	0.77	x	2.49	x	104.39		0.63	x	0.7	=	79.44	(79)

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Southwest	0.9x	0.77	x	2.49	x	92.85		0.63	x	0.7	=	70.66	(79)
Southwest	0.9x	0.77	x	2.49	x	69.27		0.63	x	0.7	=	52.71	(79)
Southwest	0.9x	0.77	x	2.49	x	44.07		0.63	x	0.7	=	33.54	(79)
Southwest	0.9x	0.77	x	2.49	x	31.49		0.63	x	0.7	=	23.96	(79)
Northwest	0.9x	0.77	x	2.55	x	11.28	x	0.63	x	0.7	=	8.79	(81)
Northwest	0.9x	0.77	x	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	0.81	x	11.28	x	0.63	x	0.7	=	2.79	(81)
Northwest	0.9x	0.77	x	0.74	x	11.28	x	0.63	x	0.7	=	2.55	(81)
Northwest	0.9x	0.77	x	2.55	x	22.97	x	0.63	x	0.7	=	17.9	(81)
Northwest	0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	0.81	x	22.97	x	0.63	x	0.7	=	5.69	(81)
Northwest	0.9x	0.77	x	0.74	x	22.97	x	0.63	x	0.7	=	5.19	(81)
Northwest	0.9x	0.77	x	2.55	x	41.38	x	0.63	x	0.7	=	32.25	(81)
Northwest	0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(81)
Northwest	0.9x	0.77	x	0.81	x	41.38	x	0.63	x	0.7	=	10.24	(81)
Northwest	0.9x	0.77	x	0.74	x	41.38	x	0.63	x	0.7	=	9.36	(81)
Northwest	0.9x	0.77	x	2.55	x	67.96	x	0.63	x	0.7	=	52.96	(81)
Northwest	0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(81)
Northwest	0.9x	0.77	x	0.81	x	67.96	x	0.63	x	0.7	=	16.82	(81)
Northwest	0.9x	0.77	x	0.74	x	67.96	x	0.63	x	0.7	=	15.37	(81)
Northwest	0.9x	0.77	x	2.55	x	91.35	x	0.63	x	0.7	=	71.19	(81)
Northwest	0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(81)
Northwest	0.9x	0.77	x	0.81	x	91.35	x	0.63	x	0.7	=	22.61	(81)
Northwest	0.9x	0.77	x	0.74	x	91.35	x	0.63	x	0.7	=	20.66	(81)
Northwest	0.9x	0.77	x	2.55	x	97.38	x	0.63	x	0.7	=	75.89	(81)
Northwest	0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(81)
Northwest	0.9x	0.77	x	0.81	x	97.38	x	0.63	x	0.7	=	24.11	(81)
Northwest	0.9x	0.77	x	0.74	x	97.38	x	0.63	x	0.7	=	22.02	(81)
Northwest	0.9x	0.77	x	2.55	x	91.1	x	0.63	x	0.7	=	71	(81)
Northwest	0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(81)
Northwest	0.9x	0.77	x	0.81	x	91.1	x	0.63	x	0.7	=	22.55	(81)
Northwest	0.9x	0.77	x	0.74	x	91.1	x	0.63	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	2.55	x	72.63	x	0.63	x	0.7	=	56.6	(81)
Northwest	0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(81)
Northwest	0.9x	0.77	x	0.81	x	72.63	x	0.63	x	0.7	=	17.98	(81)
Northwest	0.9x	0.77	x	0.74	x	72.63	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	2.55	x	50.42	x	0.63	x	0.7	=	39.29	(81)
Northwest	0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(81)
Northwest	0.9x	0.77	x	0.81	x	50.42	x	0.63	x	0.7	=	12.48	(81)
Northwest	0.9x	0.77	x	0.74	x	50.42	x	0.63	x	0.7	=	11.4	(81)
Northwest	0.9x	0.77	x	2.55	x	28.07	x	0.63	x	0.7	=	21.87	(81)

Northwest 0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(81)
Northwest 0.9x	0.77	x	0.81	x	28.07	x	0.63	x	0.7	=	6.95	(81)
Northwest 0.9x	0.77	x	0.74	x	28.07	x	0.63	x	0.7	=	6.35	(81)
Northwest 0.9x	0.77	x	2.55	x	14.2	x	0.63	x	0.7	=	11.06	(81)
Northwest 0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(81)
Northwest 0.9x	0.77	x	0.81	x	14.2	x	0.63	x	0.7	=	3.51	(81)
Northwest 0.9x	0.77	x	0.74	x	14.2	x	0.63	x	0.7	=	3.21	(81)
Northwest 0.9x	0.77	x	2.55	x	9.21	x	0.63	x	0.7	=	7.18	(81)
Northwest 0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(81)
Northwest 0.9x	0.77	x	0.81	x	9.21	x	0.63	x	0.7	=	2.28	(81)
Northwest 0.9x	0.77	x	0.74	x	9.21	x	0.63	x	0.7	=	2.08	(81)

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

(83)m=	96.08	171.04	253.62	347.09	418.74	428.9	408.02	352.54	285.67	194.32	116.43	81.36	(83)

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

(84)m=	530.26	602.82	669.95	738.02	783.6	768.87	732.48	684.21	631	565.28	516.14	502.76	(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	1	0.99	0.98	0.93	0.8	0.64	0.69	0.91	0.99	1	1	(86)

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

(87)m=	19.69	19.83	20.06	20.39	20.7	20.91	20.98	20.97	20.81	20.42	20	19.67	(87)

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

(88)m=	19.95	19.95	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.96	19.96	(88)

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

(89)m=	1	1	0.99	0.97	0.9	0.72	0.5	0.56	0.85	0.98	1	1	(89)

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

(90)m=	18.2	18.4	18.75	19.23	19.65	19.91	19.97	19.96	19.81	19.27	18.66	18.17	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.69	18.87	19.18	19.61	20	20.24	20.3	20.3	20.14	19.65	19.1	18.66	(92)

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

(93)m=	18.69	18.87	19.18	19.61	20	20.24	20.3	20.3	20.14	19.65	19.1	18.66	(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=	1	1	0.99	0.97	0.9	0.74	0.55	0.61	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	528.98	599.88	662.11	712.52	703.31	568.91	401.01	415.31	543.41	551.91	513.64	501.83	(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)

DER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(97)m=	1640.85	1589.27	1439.44	1202.48	929.72	625.87	410.72	431.36	672.59	1013.95	1349.87	1634.22		(97)

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

(98)m=	827.23	664.87	578.33	352.77	168.45	0	0	0	0	343.76	602.09	842.5		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4380 | (98)

Space heating requirement in kWh/m²/year | 44.55 | (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)	827.23	664.87	578.33	352.77	168.45	0	0	0	0	343.76	602.09	842.5		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	916.09	736.29	640.45	390.67	186.55	0	0	0	0	380.68	666.76	933		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													4850.5	(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)	212.26	187.1	196.53	174.7	169.14	148.97	142.73	159.11	160.86	182.74	193.16	207.17		
Efficiency of water heater													81	(216)
(217)m=	88.23	88.08	87.74	86.99	85.39	81	81	81	81	86.84	87.85	88.3		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	240.57	212.42	223.98	200.83	198.09	183.91	176.2	196.43	198.6	210.43	219.88	234.62		
Total = Sum(219a)$_{1...12}$ =													2495.95	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			4850.5	
Water heating fuel used			2495.95	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			433.62	(232)

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	=	1047.71	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	539.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1586.83	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	225.05	(268)
Total CO2, kg/year			sum of (265) (271) =		1827.45	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.59	(273)
EI rating (section 14)					83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 03-Lean

Address : Flat 03, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.13	(1a)	x	3.33	(2a)	=	186.91	(3a)
First floor	45.8	(1b)	x	2.2	(2b)	=	100.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	101.93	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	287.67	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.1	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.35	0.34	0.34	0.3	0.3	0.26	0.26	0.25	0.27	0.3	0.31	0.32

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=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 2			2.28	x1/[1/(1.6)+ 0.04]		=	3.43			(27)
Windows Type 3			2.34	x1/[1/(1.6)+ 0.04]		=	3.52			(27)
Floor			59.1	x	0.12	=	7.092			(28)
Walls Type1	70.52	12.54	57.98	x	0.23	=	13.34			(29)
Walls Type2	33.65	1.98	31.67	x	0.12	=	3.66			(29)
Roof	20.55	0	20.55	x	0.1	=	2.05			(30)
Total area of elements, m²			183.82							(31)
Party wall			51.98	x	0	=	0			(32)
Party floor			5.32							(32a)
Party ceiling			43.87							(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) =	47.78	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	13345	(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 | 27.57 | (36)

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

Total fabric heat loss (33) + (36) = | 75.35 | (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=	53.28	53.06	52.84	51.8	51.6	50.7	50.7	50.53	51.04	51.6	51.99	52.41	(38)

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

(39)m=	128.63	128.41	128.18	127.14	126.95	126.04	126.04	125.88	126.39	126.95	127.34	127.76

Average = Sum(39)$_{1 \ldots 12}$ /12= | 127.14 | (39)

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

(40)m=	1.26	1.26	1.26	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.25	1.25

Average = Sum(40)$_{1 \ldots 12}$ /12= | 1.25 | (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 | 2.76 | (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 | 99.67 | (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=	109.64	105.65	101.66	97.68	93.69	89.7	89.7	93.69	97.68	101.66	105.65	109.64

Total = Sum(44)$_{1 \ldots 12}$ = | 1196.06 | (44)

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

(45)m=	162.59	142.2	146.74	127.93	122.75	105.93	98.16	112.64	113.98	132.84	145	157.46

Total = Sum(45)$_{1 \ldots 12}$ = | 1568.22 | (45)

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

(46)m=	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.9	17.1	19.93	21.75	23.62	(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	48.17	47.74	44.24	45.71	47.74	48.17	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=	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42	(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=	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42	

Output from water heater (annual)₁ ₁₂ | 2149.17 | (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=	66.8	58.79	61.53	54.58	52.75	46.28	44.07	49.39	49.94	56.91	60.54	65.1	(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=	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	25.53	22.67	18.44	13.96	10.44	8.81	9.52	12.37	16.61	21.09	24.61	26.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	259.41	262.1	255.32	240.88	222.65	205.52	194.07	191.38	198.16	212.6	230.83	247.96	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(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=	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)
Water heating gains (Table 5)													
(72)m=	89.79	87.48	82.7	75.81	70.9	64.28	59.23	66.38	69.36	76.49	84.09	87.49	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	442.08	439.61	423.81	397.99	371.34	345.95	330.17	337.48	351.48	377.53	406.88	429.05	(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	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(75)
Northeast	0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(75)
Northeast	0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(75)
Northeast	0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(75)
Northeast	0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(75)
Northeast	0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(75)
Northeast	0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(75)
Northeast	0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(75)
Northeast	0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(75)
Northeast	0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(75)
Northeast	0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(75)
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	89.06	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	151.7	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	207.56	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	257.18	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	288.06	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	285.98	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	275.71	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	252.67	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	224.74	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	167.66	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	106.67	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	76.21	(77)
Southwest	0.9x	0.77	x	2.28	x	36.79		0.63	x	0.7	=	25.64	(79)
Southwest	0.9x	0.77	x	2.28	x	62.67		0.63	x	0.7	=	43.67	(79)
Southwest	0.9x	0.77	x	2.28	x	85.75		0.63	x	0.7	=	59.75	(79)
Southwest	0.9x	0.77	x	2.28	x	106.25		0.63	x	0.7	=	74.04	(79)
Southwest	0.9x	0.77	x	2.28	x	119.01		0.63	x	0.7	=	82.93	(79)
Southwest	0.9x	0.77	x	2.28	x	118.15		0.63	x	0.7	=	82.33	(79)
Southwest	0.9x	0.77	x	2.28	x	113.91		0.63	x	0.7	=	79.37	(79)
Southwest	0.9x	0.77	x	2.28	x	104.39		0.63	x	0.7	=	72.74	(79)
Southwest	0.9x	0.77	x	2.28	x	92.85		0.63	x	0.7	=	64.7	(79)
Southwest	0.9x	0.77	x	2.28	x	69.27		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.28	x	44.07		0.63	x	0.7	=	30.71	(79)
Southwest	0.9x	0.77	x	2.28	x	31.49		0.63	x	0.7	=	21.94	(79)

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

(83)m=	122.76	211.79	296.9	379.81	436.31	437.95	420.23	377.35	325.5	236	147.53	104.74	(83)

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

(84)m=	564.84	651.4	720.72	777.8	807.65	783.9	750.4	714.83	676.98	613.53	554.41	533.79	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.94	0.84	0.68	0.73	0.91	0.99	1	1	(86)

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

(87)m=	19.57	19.72	19.97	20.3	20.62	20.86	20.96	20.95	20.77	20.35	19.9	19.54	(87)

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

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.88	(88)

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

(89)m=	1	1	0.99	0.97	0.91	0.75	0.54	0.59	0.86	0.98	1	1	(89)

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

(90)m=	17.97	18.19	18.55	19.03	19.48	19.79	19.88	19.87	19.69	19.12	18.46	17.93	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)m=	18.4	18.6	18.93	19.38	19.79	20.08	20.17	20.16	19.98	19.45	18.85	18.37	(92)

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

(93)m=	18.4	18.6	18.93	19.38	19.79	20.08	20.17	20.16	19.98	19.45	18.85	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=	1	0.99	0.99	0.97	0.91	0.77	0.58	0.63	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	563.16	647.45	711	750.89	733.29	603.57	433.18	448.5	583.39	596.96	551.13	532.57	(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=	1813.95	1759.49	1593.82	1331.85	1027.03	690.81	450	473.43	743.17	1123.64	1495.85	1809.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	930.59	747.29	656.82	418.29	218.54	0	0	0	0	391.85	680.2	950.37	

Total per year (kWh/year) = Sum(98)1...5,9...12 = | 4993.95 | (98)

Space heating requirement in kWh/m²/year | 48.99 | (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)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	930.59	747.29	656.82	418.29	218.54	0	0	0	0	391.85	680.2	950.37		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1030.55	827.56	727.38	463.23	242.02	0	0	0	0	433.94	753.26	1052.46		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5530.39	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	213.55	188.23	197.7	176.1	170.5	150.16	143.87	160.38	162.15	183.79	194.31	208.42		
Efficiency of water heater													81	(216)
(217)m=	88.41	88.26	87.96	87.33	85.97	81	81	81	81	87.11	88.05	88.47		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	241.56	213.27	224.75	201.65	198.31	185.39	177.62	198	200.19	211	220.68	235.57		
Total = Sum(219a)$_{1...12}$ =													2507.98	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5530.39	
Water heating fuel used			2507.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a) (230g) =		30	(231)
Electricity for lighting			450.84	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1194.57	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	541.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1736.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	233.99	(268)
Total CO2, kg/year		sum of (265) (271) =		1985.85	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.48	(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: 1.0.4.26

Property Address: Flat 04-Lean

Address : Flat 04, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83.77	(1a)	x	3.06	(2a)	=	256.34	(3a)
First floor	20.32	(1b)	x	2.2	(2b)	=	44.7	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	104.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	301.04	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1.4	=	2.772			(26)
Windows Type 1			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 2			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 3			0.69	x1/[1/(1.6)+ 0.04]		=	1.04			(27)
Windows Type 4			1.8	x1/[1/(1.2)+ 0.04]		=	2.06			(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 6			8.66	x1/[1/(1.2)+ 0.04]		=	9.92			(27)
Windows Type 7			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Floor			83.77	x	0.12	=	10.0524			(28)
Walls Type1	55.67	9.01	46.66	x	0.23	=	10.73			(29)
Walls Type2	19.9	1.98	17.92	x	0.12	=	2.07			(29)
Walls Type3	36.42	11.9	24.52	x	0.12	=	2.94			(29)
Roof	13.01	0	13.01	x	0.1	=	1.3			(30)
Total area of elements, m²			208.77							(31)
Party wall			58.33	x	0	=	0			(32)
Party ceiling			70.76							(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) = 57.05 (33)

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Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	18376.29	(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		31.32	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	88.36	(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=	59.8	59.41	59.02	57.21	56.87	55.29	55.29	55	55.9	56.87	57.56	58.27	(38)

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

(39)m=	148.16	147.77	147.38	145.57	145.23	143.66	143.66	143.37	144.27	145.23	145.92	146.64	

Average = Sum(39)1…12 /12= 145.57 (39)

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

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

Average = Sum(40)1…12 /12= 1.4 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.77 (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) + 36 100.09 (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=	110.1	106.09	102.09	98.09	94.08	90.08	90.08	94.08	98.09	102.09	106.09	110.1	

Total = Sum(44)1…12 = 1201.08 (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=	163.27	142.8	147.36	128.47	123.27	106.37	98.57	113.11	114.46	133.39	145.61	158.12	

Total = Sum(45)1…12 = 1574.8 (45)

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

(46)m=	24.49	21.42	22.1	19.27	18.49	15.96	14.79	16.97	17.17	20.01	21.84	23.72	(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:

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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	48.37	47.94	44.42	45.9	47.94	48.37	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=	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08	(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=	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08	

Output from water heater (annual)$_{1\ 12}$ — 2156.94 (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=	67.03	58.99	61.74	54.81	52.97	46.47	44.25	49.59	50.15	57.09	60.74	65.32	(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=	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.58	20.94	17.03	12.9	9.64	8.14	8.79	11.43	15.34	19.48	22.73	24.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	262.78	265.5	258.63	244	225.54	208.18	196.59	193.86	200.73	215.36	233.83	251.18	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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=	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating gains (Table 5)													
(72)m=	90.09	87.78	82.98	76.12	71.2	64.55	59.48	66.66	69.65	76.74	84.37	87.79	(72)

DER WorkSheet: New dwelling design stage

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

(73)m=	444.06	441.84	426.26	400.64	373.99	348.48	332.47	339.56	353.34	379.19	408.54	430.82	(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	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast	0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)
Northeast	0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast	0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast	0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast	0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast	0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast	0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast	0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast	0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast	0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast	0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
East	0.9x	0.77	x	0.69	x	19.64	x	0.63	x	0.7	=	4.14	(76)
East	0.9x	0.77	x	1.8	x	19.64	x	0.5	x	0.7	=	8.57	(76)
East	0.9x	0.77	x	1.44	x	19.64	x	0.5	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	0.69	x	38.42	x	0.63	x	0.7	=	8.1	(76)
East	0.9x	0.77	x	1.8	x	38.42	x	0.5	x	0.7	=	16.77	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.5	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	0.69	x	63.27	x	0.63	x	0.7	=	13.34	(76)
East	0.9x	0.77	x	1.8	x	63.27	x	0.5	x	0.7	=	27.62	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.5	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	0.69	x	92.28	x	0.63	x	0.7	=	19.46	(76)
East	0.9x	0.77	x	1.8	x	92.28	x	0.5	x	0.7	=	40.29	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.5	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	0.69	x	113.09	x	0.63	x	0.7	=	23.85	(76)
East	0.9x	0.77	x	1.8	x	113.09	x	0.5	x	0.7	=	49.38	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.5	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	0.69	x	115.77	x	0.63	x	0.7	=	24.41	(76)
East	0.9x	0.77	x	1.8	x	115.77	x	0.5	x	0.7	=	50.54	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.5	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	0.69	x	110.22	x	0.63	x	0.7	=	23.24	(76)
East	0.9x	0.77	x	1.8	x	110.22	x	0.5	x	0.7	=	48.12	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.5	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	0.69	x	94.68	x	0.63	x	0.7	=	19.96	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.8	x	94.68	x	0.5	x	0.7	=	41.33	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.5	x	0.7	=	33.07	(76)
East	0.9x	0.77	x	0.69	x	73.59	x	0.63	x	0.7	=	15.52	(76)
East	0.9x	0.77	x	1.8	x	73.59	x	0.5	x	0.7	=	32.13	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.5	x	0.7	=	25.7	(76)
East	0.9x	0.77	x	0.69	x	45.59	x	0.63	x	0.7	=	9.61	(76)
East	0.9x	0.77	x	1.8	x	45.59	x	0.5	x	0.7	=	19.9	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.5	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	0.69	x	24.49	x	0.63	x	0.7	=	5.16	(76)
East	0.9x	0.77	x	1.8	x	24.49	x	0.5	x	0.7	=	10.69	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.5	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	0.69	x	16.15	x	0.63	x	0.7	=	3.41	(76)
East	0.9x	0.77	x	1.8	x	16.15	x	0.5	x	0.7	=	7.05	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.5	x	0.7	=	5.64	(76)
Southeast	0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast	0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast	0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast	0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast	0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast	0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast	0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast	0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast	0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast	0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast	0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast	0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Northwest	0.9x	0.77	x	8.66	x	11.28	x	0.5	x	0.7	=	23.7	(81)
Northwest	0.9x	0.77	x	8.66	x	22.97	x	0.5	x	0.7	=	48.24	(81)
Northwest	0.9x	0.77	x	8.66	x	41.38	x	0.5	x	0.7	=	86.92	(81)

Northwest	0.9x	0.77	x	8.66	x	67.96	x	0.5	x	0.7	=	142.74	(81)
Northwest	0.9x	0.77	x	8.66	x	91.35	x	0.5	x	0.7	=	191.87	(81)
Northwest	0.9x	0.77	x	8.66	x	97.38	x	0.5	x	0.7	=	204.55	(81)
Northwest	0.9x	0.77	x	8.66	x	91.1	x	0.5	x	0.7	=	191.36	(81)
Northwest	0.9x	0.77	x	8.66	x	72.63	x	0.5	x	0.7	=	152.55	(81)
Northwest	0.9x	0.77	x	8.66	x	50.42	x	0.5	x	0.7	=	105.91	(81)
Northwest	0.9x	0.77	x	8.66	x	28.07	x	0.5	x	0.7	=	58.95	(81)
Northwest	0.9x	0.77	x	8.66	x	14.2	x	0.5	x	0.7	=	29.82	(81)
Northwest	0.9x	0.77	x	8.66	x	9.21	x	0.5	x	0.7	=	19.35	(81)

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

(83)m=	103.77	194.44	310.53	455.26	571.35	593.46	561.3	471.19	360.37	227.13	127.58	86.65	(83)

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

(84)m=	547.84	636.28	736.78	855.9	945.35	941.94	893.77	810.76	713.71	606.33	536.12	517.48	(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	0.92	0.8	0.65	0.72	0.92	0.99	1	1	(86)

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

(87)m=	19.34	19.5	19.79	20.2	20.59	20.86	20.96	20.94	20.71	20.21	19.71	19.32	(87)

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

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

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

(89)m=	1	1	0.99	0.97	0.89	0.71	0.5	0.57	0.86	0.98	1	1	(89)

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

(90)m=	17.55	17.78	18.21	18.81	19.35	19.68	19.76	19.75	19.52	18.84	18.1	17.53	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	18.15	18.36	18.74	19.27	19.76	20.07	20.16	20.15	19.91	19.3	18.64	18.13	(92)

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

(93)m=	18.15	18.36	18.74	19.27	19.76	20.07	20.16	20.15	19.91	19.3	18.64	18.13	(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=	1	0.99	0.99	0.96	0.89	0.73	0.55	0.62	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	546.37	632.91	727.16	822.17	838.93	690.82	491.39	503.42	622.36	592.79	533.46	516.4	(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=	2052.19	1988.41	1803.55	1510.28	1170.73	786.29	511.7	537.27	838.89	1262.88	1683.87	2042.42	(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=	1120.33	910.9	800.83	495.43	246.86	0	0	0	0	498.55	828.29	1135.36		

Total per year (kWh/year) = Sum(98)1...5,9...12 = 6036.55 (98)

Space heating requirement in kWh/m²/year 57.99 (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)	1120.33	910.9	800.83	495.43	246.86	0	0	0	0	498.55	828.29	1135.36		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1240.67	1008.75	886.86	548.65	273.38	0	0	0	0	552.1	917.27	1257.32		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													6685	(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)	214.23	188.83	198.32	176.84	171.21	150.8	144.47	161.05	162.83	184.35	194.92	209.08		
Efficiency of water heater													81	(216)
(217)m=	88.67	88.55	88.29	87.65	86.24	81	81	81	81	87.59	88.37	88.72		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	241.62	213.23	224.62	201.75	198.52	186.17	178.36	198.83	201.03	210.48	220.58	235.67		
Total = Sum(219a)1...12 =													2510.87	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			6685	
Water heating fuel used			2510.87	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		30	(231)
Electricity for lighting			416.45	(232)

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	=	1443.96	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	542.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1986.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	216.14	(268)
Total CO2, kg/year		sum of (265) (271) =		2218.01	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.31	(273)
EI rating (section 14)				80	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 05-Lean

Address : Flat 05, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.09	(1a) x	2.4	(2a) =	180.22	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.09	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		180.22	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.17	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.39	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Windows Type 2			2.03	x1/[1/(1.6)+ 0.04]		=	3.05			(27)
Floor			75.09	x	0.12	=	9.010799			(28)
Walls Type1	52.54	8.3	44.24	x	0.23	=	10.18			(29)
Walls Type2	8.28	1.98	6.3	x	0.12	=	0.73			(29)
Roof	9.64	0	9.64	x	0.12	=	1.16			(30)
Total area of elements, m²			145.55							(31)
Party wall			40.53	x	0	=	0			(32)
Party ceiling			65.45							(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) = 36.32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16157.12 (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 21.83 (36)

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

Total fabric heat loss (33) + (36) = 58.16 (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=	36.91	36.63	36.36	35.08	34.84	33.72	33.72	33.51	34.15	34.84	35.32	35.83	(38)

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

(39)m=	95.07	94.79	94.52	93.23	92.99	91.88	91.88	91.67	92.31	92.99	93.48	93.99	

Average = Sum(39)$_{1...12}$ /12= 93.23 (39)

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

(40)m=	1.27	1.26	1.26	1.24	1.24	1.22	1.22	1.22	1.23	1.24	1.24	1.25

Average = Sum(40)$_{1...12}$ /12= 1.24 (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 2.36 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.32 (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=	99.36	95.74	92.13	88.52	84.9	81.29	81.29	84.9	88.52	92.13	95.74	99.36

Total = Sum(44)$_{1...12}$ = 1083.89 (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=	147.34	128.87	132.98	115.93	111.24	95.99	88.95	102.07	103.29	120.38	131.4	142.69

Total = Sum(45)$_{1...12}$ = 1421.15 (45)

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

(46)m=	22.1	19.33	19.95	17.39	16.69	14.4	13.34	15.31	15.49	18.06	19.71	21.4	(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=	50.63	44.07	46.95	43.65	43.27	40.09	41.43	43.27	43.65	46.95	47.22	50.63	(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=	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32	(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=	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32

Output from water heater (annual)$_{1 \ldots 12}$ | 1962.94 | (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=	61.65	53.87	55.95	49.46	47.8	41.94	39.93	44.76	45.26	51.76	55.49	60.1	(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=	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.05	18.69	15.2	11.51	8.6	7.26	7.85	10.2	13.69	17.38	20.29	21.63	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	208.87	211.04	205.58	193.95	179.27	165.48	156.26	154.1	159.56	171.18	185.86	199.66	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	(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=	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	(71)
Water heating gains (Table 5)													
(72)m=	82.86	80.16	75.21	68.7	64.25	58.25	53.67	60.16	62.86	69.57	77.08	80.78	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	374.23	371.34	357.43	335.6	313.58	292.44	279.23	285.9	297.55	319.59	344.68	363.52	(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	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast 0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)

Northeast 0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast 0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast 0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast 0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast 0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast 0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast 0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast 0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast 0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast 0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
Southwest 0.9x	0.77	x	2.03	x	36.79		0.63	x	0.7	=	45.65	(79)
Southwest 0.9x	0.77	x	2.03	x	62.67		0.63	x	0.7	=	77.76	(79)
Southwest 0.9x	0.77	x	2.03	x	85.75		0.63	x	0.7	=	106.4	(79)
Southwest 0.9x	0.77	x	2.03	x	106.25		0.63	x	0.7	=	131.84	(79)
Southwest 0.9x	0.77	x	2.03	x	119.01		0.63	x	0.7	=	147.67	(79)
Southwest 0.9x	0.77	x	2.03	x	118.15		0.63	x	0.7	=	146.6	(79)
Southwest 0.9x	0.77	x	2.03	x	113.91		0.63	x	0.7	=	141.34	(79)
Southwest 0.9x	0.77	x	2.03	x	104.39		0.63	x	0.7	=	129.53	(79)
Southwest 0.9x	0.77	x	2.03	x	92.85		0.63	x	0.7	=	115.21	(79)
Southwest 0.9x	0.77	x	2.03	x	69.27		0.63	x	0.7	=	85.95	(79)
Southwest 0.9x	0.77	x	2.03	x	44.07		0.63	x	0.7	=	54.68	(79)
Southwest 0.9x	0.77	x	2.03	x	31.49		0.63	x	0.7	=	39.07	(79)

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

(83)m=	60.27	107.52	160.02	219.89	266.03	272.79	259.39	223.64	180.54	122.32	73.08	51.01	(83)

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

(84)m=	434.5	478.86	517.45	555.5	579.61	565.23	538.62	509.54	478.1	441.91	417.76	414.53	(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	0.94	0.84	0.69	0.74	0.92	0.99	1	1	(86)

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

(87)m=	19.59	19.71	19.95	20.28	20.61	20.86	20.96	20.95	20.76	20.35	19.91	19.57	(87)

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

(88)m=	19.87	19.87	19.87	19.89	19.89	19.9	19.9	19.9	19.9	19.89	19.88	19.88	(88)

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

(89)m=	1	1	0.99	0.97	0.92	0.76	0.55	0.6	0.87	0.98	1	1	(89)

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

(90)m=	17.99	18.18	18.52	19.02	19.47	19.8	19.89	19.88	19.68	19.11	18.48	17.97	(90)

fLA = Living area ÷ (4) = | 0.36 | (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	18.56	18.73	19.04	19.47	19.88	20.18	20.27	20.26	20.07	19.56	19	18.55	(92)

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

(93)m=	18.56	18.73	19.04	19.47	19.88	20.18	20.27	20.26	20.07	19.56	19	18.55	(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	0.78	0.6	0.65	0.88	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	433.03	476.09	511.35	538.76	531.49	443.39	322.94	332.53	420.51	431.33	415.18	413.4	(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=	1356.02	1311	1184.86	985.59	760.92	512.69	337.35	354	550.89	832.8	1112.03	1348.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	686.71	561.06	501.09	321.71	170.7	0	0	0	0	298.69	501.73	695.61	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3737.3 (98)

Space heating requirement in kWh/m²/year 49.77 (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		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)													
	686.71	561.06	501.09	321.71	170.7	0	0	0	0	298.69	501.73	695.61	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	760.47	621.33	554.91	356.27	189.04	0	0	0	0	330.78	555.63	770.33	

Total (kWh/year) =Sum(211)1...5,10...12= 4138.76 (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)

	197.97	172.93	179.93	159.59	154.51	136.08	130.38	145.34	146.94	167.33	178.62	193.32

Efficiency of water heater 81 (216)

(217)m=	88.04	87.92	87.64	86.99	85.63	81	81	81	81	86.72	87.66	88.1	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	224.87	196.69	205.3	183.46	180.44	168	160.96	179.43	181.41	192.94	203.77	219.44

Total = Sum(219a)1...12 = 2296.71 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4138.76	
Water heating fuel used			2296.71	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a) (230g) =		30	(231)
Electricity for lighting			371.68	(232)

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

	Energy kWh/year	**Emission factor** kg CO_2/kWh		**Emissions** kg CO_2/year	
Space heating (main system 1)	(211) x	0.216	=	893.97	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	496.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1390.06	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	192.9	(268)
Total CO_2, kg/year		sum of (265) (271) =		1598.53	(272)
Dwelling CO_2 Emission Rate		(272) ÷ (4) =		21.29	(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: 1.0.4.26

Property Address: Flat 06-Lean

Address : Flat 06, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.21	(1a) x	2.2	(2a) =	117.06	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.21	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	117.06	(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) =	76.5	(23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			4.95	x1/[1/(1.2)+ 0.04]		=	5.67			(27)
Windows Type 2			1.67	x1/[1/(1.2)+ 0.04]		=	1.91			(27)
Walls Type1	29.77	8.29	21.48	x	0.12	=	2.58			(29)
Walls Type2	11.99	1.98	10.01	x	0.12	=	1.16			(29)
Roof	38.74	0	38.74	x	0.12	=	4.65			(30)
Total area of elements, m²			80.5							(31)
Party wall			39.44	x	0	=	0			(32)
Party floor			53.21							(32a)
Party ceiling			14.48							(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) =	20.65	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	7125.67	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		12.08	(36)

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

Total fabric heat loss	(33) + (36) =	32.72	(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=	10.82	10.7	10.57	9.96	9.83	9.22	9.22	9.1	9.46	9.83	10.08	10.33	(38)

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

(39)m=	43.54	43.42	43.3	42.68	42.56	41.94	41.94	41.82	42.19	42.56	42.8	43.05	

Average = Sum(39)1…12 /12= 42.65 (39)

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

(40)m=	0.82	0.82	0.81	0.8	0.8	0.79	0.79	0.79	0.79	0.8	0.8	0.81	

Average = Sum(40)1…12 /12= 0.8 (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 1.78 (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 76.59 (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=	84.25	81.18	78.12	75.06	71.99	68.93	68.93	71.99	75.06	78.12	81.18	84.25	

Total = Sum(44)1…12 = 919.05 (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=	124.94	109.27	112.76	98.3	94.32	81.39	75.42	86.55	87.58	102.07	111.42	120.99	

Total = Sum(45)1…12 = 1205.02 (45)

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

(46)m=	18.74	16.39	16.91	14.75	14.15	12.21	11.31	12.98	13.14	15.31	16.71	18.15	(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=	42.93	37.37	39.81	37.01	36.69	33.99	35.13	36.69	37.01	39.81	40.04	42.93	(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=	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92	(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=	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92

Output from water heater (annual)$_{1}$ $_{12}$ | 1664.43 | (64)

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

(65)m=	52.27	45.67	47.44	41.94	40.53	35.56	33.86	37.95	38.38	43.89	47.06	50.96	(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=	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	(66)

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

(67)m=	14.55	12.92	10.51	7.95	5.95	5.02	5.42	7.05	9.46	12.02	14.02	14.95	(67)

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

(68)m=	155.56	157.18	153.11	144.45	133.52	123.24	116.38	114.76	118.83	127.49	138.42	148.7	(68)

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

(69)m=	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	(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=	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	(71)

Water heating gains (Table 5)

(72)m=	70.26	67.97	63.77	58.25	54.48	49.39	45.51	51.01	53.3	58.99	65.35	68.5	(72)

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

(73)m=	293.14	290.83	280.15	263.42	246.72	230.42	220.08	225.59	234.37	251.27	270.57	284.92	(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	4.95	x	11.28	x	0.5	x	0.7	=	13.55	(75)
Northeast 0.9x	0.77	x	4.95	x	22.97	x	0.5	x	0.7	=	27.57	(75)

Northeast	0.9x	0.77	x	4.95	x	41.38	x	0.5	x	0.7	=	49.68	(75)
Northeast	0.9x	0.77	x	4.95	x	67.96	x	0.5	x	0.7	=	81.59	(75)
Northeast	0.9x	0.77	x	4.95	x	91.35	x	0.5	x	0.7	=	109.67	(75)
Northeast	0.9x	0.77	x	4.95	x	97.38	x	0.5	x	0.7	=	116.92	(75)
Northeast	0.9x	0.77	x	4.95	x	91.1	x	0.5	x	0.7	=	109.38	(75)
Northeast	0.9x	0.77	x	4.95	x	72.63	x	0.5	x	0.7	=	87.2	(75)
Northeast	0.9x	0.77	x	4.95	x	50.42	x	0.5	x	0.7	=	60.54	(75)
Northeast	0.9x	0.77	x	4.95	x	28.07	x	0.5	x	0.7	=	33.7	(75)
Northeast	0.9x	0.77	x	4.95	x	14.2	x	0.5	x	0.7	=	17.05	(75)
Northeast	0.9x	0.77	x	4.95	x	9.21	x	0.5	x	0.7	=	11.06	(75)
Northwest	0.9x	0.77	x	1.67	x	11.28	x	0.5	x	0.7	=	9.14	(81)
Northwest	0.9x	0.77	x	1.67	x	22.97	x	0.5	x	0.7	=	18.61	(81)
Northwest	0.9x	0.77	x	1.67	x	41.38	x	0.5	x	0.7	=	33.52	(81)
Northwest	0.9x	0.77	x	1.67	x	67.96	x	0.5	x	0.7	=	55.05	(81)
Northwest	0.9x	0.77	x	1.67	x	91.35	x	0.5	x	0.7	=	74	(81)
Northwest	0.9x	0.77	x	1.67	x	97.38	x	0.5	x	0.7	=	78.89	(81)
Northwest	0.9x	0.77	x	1.67	x	91.1	x	0.5	x	0.7	=	73.8	(81)
Northwest	0.9x	0.77	x	1.67	x	72.63	x	0.5	x	0.7	=	58.84	(81)
Northwest	0.9x	0.77	x	1.67	x	50.42	x	0.5	x	0.7	=	40.85	(81)
Northwest	0.9x	0.77	x	1.67	x	28.07	x	0.5	x	0.7	=	22.74	(81)
Northwest	0.9x	0.77	x	1.67	x	14.2	x	0.5	x	0.7	=	11.5	(81)
Northwest	0.9x	0.77	x	1.67	x	9.21	x	0.5	x	0.7	=	7.46	(81)

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

(83)m=	22.69	46.18	83.2	136.64	183.67	195.81	183.18	146.03	101.38	56.44	28.55	18.53	(83)

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

(84)m=	315.83	337.01	363.36	400.06	430.39	426.24	403.27	371.63	335.75	307.71	299.12	303.45	(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=	0.96	0.95	0.92	0.85	0.74	0.57	0.44	0.49	0.71	0.88	0.95	0.97	(86)

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

(87)m=	19.39	19.56	19.89	20.33	20.7	20.91	20.97	20.96	20.8	20.35	19.81	19.36	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.25	(88)

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

(89)m=	0.96	0.94	0.91	0.84	0.7	0.52	0.37	0.42	0.66	0.86	0.94	0.96	(89)

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

(90)m=	18.06	18.3	18.77	19.41	19.9	20.17	20.24	20.23	20.05	19.44	18.67	18.02	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	18.64	18.85	19.26	19.81	20.25	20.49	20.56	20.55	20.38	19.84	19.17	18.6	(92)

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

(93)m=	18.64	18.85	19.26	19.81	20.25	20.49	20.56	20.55	20.38	19.84	19.17	18.6	(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=	0.94	0.93	0.9	0.82	0.7	0.54	0.4	0.45	0.67	0.85	0.92	0.95	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	297.97	313.07	325.51	329.06	301.29	228.66	160.93	166.04	225.35	262.23	276.2	287.95	(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=	624.4	605.72	552.38	465.74	363.78	247.11	166.04	173.48	264.78	393.11	516.49	620.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	242.86	196.67	168.79	98.41	46.49	0	0	0	0	97.38	173.01	247.1	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1270.69 (98)

Space heating requirement in kWh/m²/year 23.88 (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)													
	242.86	196.67	168.79	98.41	46.49	0	0	0	0	97.38	173.01	247.1	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	268.95	217.79	186.92	108.98	51.48	0	0	0	0	107.84	191.6	273.64	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1407.19 (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)

	167.87	146.64	152.56	135.32	131.01	115.39	110.55	123.24	124.6	141.88	151.45	163.92	
Efficiency of water heater												81	(216)
(217)m=	86.25	86.08	85.63	84.67	83.25	81	81	81	81	84.54	85.71	86.35	(217)

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

(219)m=	194.62	170.35	178.16	159.81	157.38	142.45	136.48	152.14	153.82	167.82	176.71	189.85

Total = Sum(219a)$_{1...12}$ = 1979.61 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1407.19	
Water heating fuel used			1979.61	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		103.54		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a) (230g) =		133.54	(231)
Electricity for lighting			256.89	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	303.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	427.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			731.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	69.31	(267)
Electricity for lighting	(232) x	0.519	=	133.32	(268)
Total CO2, kg/year		sum of (265) (271) =		934.18	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.56	(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: 1.0.4.26

Property Address: Flat 07-Lean

Address : Flat 07, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	63.73	(1a)	x	2.2	(2a)	=	140.21	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.73	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	140.21	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 76.5 (23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			3.4	x1/[1/(1.2)+ 0.04]		=	3.89			(27)
Windows Type 2			1.8	x1/[1/(1.2)+ 0.04]		=	2.06			(27)
Windows Type 3			2.07	x1/[1/(1.2)+ 0.04]		=	2.37			(27)
Walls Type1	51.69	10.87	40.82	x	0.12	=	4.9			(29)
Walls Type2	9.19	1.98	7.21	x	0.12	=	0.83			(29)
Roof	63.73	0	63.73	x	0.12	=	7.65			(30)
Total area of elements, m²			124.61							(31)
Party wall			28.69	x	0	=	0			(32)
Party floor			63.73							(32a)
Party ceiling			14.48							(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) = 28.6 (33)

Heat capacity Cm = S(A x k) ((28) (30) + (32) + (32a) (32e) = 8126.04 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 18.69 (36)

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

Total fabric heat loss (33) + (36) = 47.29 (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=	13.62	13.46	13.3	12.5	12.34	11.54	11.54	11.37	11.86	12.34	12.66	12.98	(38)

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

(39)m=	60.91	60.75	60.59	59.79	59.63	58.83	58.83	58.66	59.15	59.63	59.95	60.27	

Average = Sum(39)$_{1...12}$ /12= 59.75 (39)

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

(40)m=	0.96	0.95	0.95	0.94	0.94	0.92	0.92	0.92	0.93	0.94	0.94	0.95	

Average = Sum(40)$_{1...12}$ /12= 0.94 (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 2.08 (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 83.72 (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	
(44)m=	92.09	88.74	85.39	82.04	78.69	75.34	75.34	78.69	82.04	85.39	88.74	92.09	

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

Total = Sum(44)$_{1...12}$ = 1004.6 (44)

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

(45)m=	136.56	119.44	123.25	107.45	103.1	88.97	82.44	94.61	95.74	111.57	121.79	132.25	

Total = Sum(45)$_{1...12}$ = 1317.18 (45)

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

(46)m=	20.48	17.92	18.49	16.12	15.47	13.35	12.37	14.19	14.36	16.74	18.27	19.84	(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=	46.93	40.84	43.51	40.46	40.1	37.16	38.39	40.1	40.46	43.51	43.76	46.93	(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=	183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18	(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=	183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18

Output from water heater (annual)$_{1\ 12}$ | 1819.34 | (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=	57.14	49.92	51.86	45.84	44.31	38.87	37.01	41.48	41.95	47.98	51.44	55.71	(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=	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	(66)

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

(67)m=	16.75	14.87	12.1	9.16	6.85	5.78	6.24	8.12	10.9	13.83	16.15	17.21	(67)

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

(68)m=	182.25	184.14	179.37	169.23	156.42	144.38	136.34	134.45	139.22	149.36	162.17	174.21	(68)

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

(69)m=	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	(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=	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	(71)

Water heating gains (Table 5)

(72)m=	76.8	74.29	69.7	63.67	59.55	53.99	49.75	55.76	58.26	64.48	71.44	74.87	(72)

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

(73)m=	333.07	330.58	318.45	299.33	280.09	261.42	249.61	255.6	265.64	284.95	307.03	323.57	(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	3.4	x	11.28	x	0.5	x	0.7	=	9.3	(75)
Northeast	0.9x	0.77	x	3.4	x	22.97	x	0.5	x	0.7	=	18.94	(75)
Northeast	0.9x	0.77	x	3.4	x	41.38	x	0.5	x	0.7	=	34.12	(75)
Northeast	0.9x	0.77	x	3.4	x	67.96	x	0.5	x	0.7	=	56.04	(75)
Northeast	0.9x	0.77	x	3.4	x	91.35	x	0.5	x	0.7	=	75.33	(75)
Northeast	0.9x	0.77	x	3.4	x	97.38	x	0.5	x	0.7	=	80.31	(75)
Northeast	0.9x	0.77	x	3.4	x	91.1	x	0.5	x	0.7	=	75.13	(75)
Northeast	0.9x	0.77	x	3.4	x	72.63	x	0.5	x	0.7	=	59.89	(75)
Northeast	0.9x	0.77	x	3.4	x	50.42	x	0.5	x	0.7	=	41.58	(75)
Northeast	0.9x	0.77	x	3.4	x	28.07	x	0.5	x	0.7	=	23.15	(75)
Northeast	0.9x	0.77	x	3.4	x	14.2	x	0.5	x	0.7	=	11.71	(75)
Northeast	0.9x	0.77	x	3.4	x	9.21	x	0.5	x	0.7	=	7.6	(75)
Northwest	0.9x	0.77	x	1.8	x	11.28	x	0.5	x	0.7	=	14.78	(81)
Northwest	0.9x	0.77	x	2.07	x	11.28	x	0.5	x	0.7	=	5.66	(81)
Northwest	0.9x	0.77	x	1.8	x	22.97	x	0.5	x	0.7	=	30.08	(81)
Northwest	0.9x	0.77	x	2.07	x	22.97	x	0.5	x	0.7	=	11.53	(81)
Northwest	0.9x	0.77	x	1.8	x	41.38	x	0.5	x	0.7	=	54.2	(81)
Northwest	0.9x	0.77	x	2.07	x	41.38	x	0.5	x	0.7	=	20.78	(81)
Northwest	0.9x	0.77	x	1.8	x	67.96	x	0.5	x	0.7	=	89.01	(81)
Northwest	0.9x	0.77	x	2.07	x	67.96	x	0.5	x	0.7	=	34.12	(81)
Northwest	0.9x	0.77	x	1.8	x	91.35	x	0.5	x	0.7	=	119.64	(81)
Northwest	0.9x	0.77	x	2.07	x	91.35	x	0.5	x	0.7	=	45.86	(81)
Northwest	0.9x	0.77	x	1.8	x	97.38	x	0.5	x	0.7	=	127.55	(81)
Northwest	0.9x	0.77	x	2.07	x	97.38	x	0.5	x	0.7	=	48.89	(81)
Northwest	0.9x	0.77	x	1.8	x	91.1	x	0.5	x	0.7	=	119.32	(81)
Northwest	0.9x	0.77	x	2.07	x	91.1	x	0.5	x	0.7	=	45.74	(81)
Northwest	0.9x	0.77	x	1.8	x	72.63	x	0.5	x	0.7	=	95.12	(81)
Northwest	0.9x	0.77	x	2.07	x	72.63	x	0.5	x	0.7	=	36.46	(81)
Northwest	0.9x	0.77	x	1.8	x	50.42	x	0.5	x	0.7	=	66.04	(81)
Northwest	0.9x	0.77	x	2.07	x	50.42	x	0.5	x	0.7	=	25.32	(81)
Northwest	0.9x	0.77	x	1.8	x	28.07	x	0.5	x	0.7	=	36.76	(81)
Northwest	0.9x	0.77	x	2.07	x	28.07	x	0.5	x	0.7	=	14.09	(81)
Northwest	0.9x	0.77	x	1.8	x	14.2	x	0.5	x	0.7	=	18.59	(81)
Northwest	0.9x	0.77	x	2.07	x	14.2	x	0.5	x	0.7	=	7.13	(81)
Northwest	0.9x	0.77	x	1.8	x	9.21	x	0.5	x	0.7	=	12.07	(81)
Northwest	0.9x	0.77	x	2.07	x	9.21	x	0.5	x	0.7	=	4.63	(81)

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

(83)m=	29.75	60.55	109.1	179.17	240.84	256.76	240.19	191.48	132.94	74	37.43	24.29	(83)

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

(84)m=	362.81	391.13	427.54	478.5	520.93	518.18	489.8	447.08	398.58	358.95	344.46	347.86	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.97	0.96	0.93	0.88	0.77	0.62	0.49	0.54	0.76	0.91	0.96	0.97	(86)

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

(87)m=	19	19.19	19.56	20.08	20.54	20.83	20.94	20.92	20.68	20.11	19.48	18.97	(87)

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

(88)m=	20.12	20.12	20.12	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13	(88)

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

(89)m=	0.96	0.95	0.93	0.86	0.74	0.56	0.41	0.46	0.71	0.89	0.95	0.97	(89)

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

(90)m=	17.42	17.69	18.23	18.98	19.61	19.99	20.11	20.09	19.81	19.03	18.12	17.37	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.16	18.39	18.85	19.5	20.04	20.39	20.5	20.48	20.22	19.54	18.76	18.12	(92)

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

(93)m=	18.16	18.39	18.85	19.5	20.04	20.39	20.5	20.48	20.22	19.54	18.76	18.12	(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=	0.95	0.94	0.91	0.84	0.73	0.58	0.44	0.49	0.71	0.87	0.93	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	344.86	366.62	388.03	402.89	380.91	299.81	216.21	220.79	283.92	313.38	321.7	332.33	(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=	844.23	819.63	748.44	633.53	497.48	340.34	229.28	239.2	361.79	532.82	698.86	839.03	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	371.53	304.42	268.15	166.06	86.73	0	0	0	0	163.26	271.55	376.98	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2008.7 (98)

Space heating requirement in kWh/m²/year 31.52 (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)													
	371.53	304.42	268.15	166.06	86.73	0	0	0	0	163.26	271.55	376.98	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	411.44	337.12	296.96	183.9	96.05	0	0	0	0	180.8	300.72	417.48	

Total (kWh/year) =Sum(211)1...5,10...12= 2224.48 (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)

183.49	160.28	166.76	147.91	143.21	126.13	120.84	134.71	136.2	155.09	165.55	179.18

Efficiency of water heater 81 (216)

(217)m=	87	86.86	86.49	85.67	84.27	81	81	81	81	85.52	86.54	87.08	(217)

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

(219)m=	210.91	184.53	192.81	172.66	169.93	155.71	149.18	166.31	168.14	181.35	191.31	205.77

Total = Sum(219a)$_{1...12}$ = 2148.61 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2224.48	
Water heating fuel used		2148.61	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	124.01		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		154.01	(231)
Electricity for lighting		295.76	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	480.49	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	464.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			944.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	79.93	(267)
Electricity for lighting	(232) x	0.519	=	153.5	(268)
Total CO2, kg/year		sum of (265)…(271) =		1178.02	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.48	(273)
EI rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 08-Lean

Address : Flat 08, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	7.67	(1a)	x	2.5	(2a)	=	19.18	(3a)
First floor	138.42	(1b)	x	2.5	(2b)	=	346.05	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	146.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	365.22	(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			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.15	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.18

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) = 73.1 (23c)

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

(24a)m=	0.33	0.32	0.32	0.3	0.3	0.28	0.28	0.27	0.28	0.3	0.3	0.31	(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=	0.33	0.32	0.32	0.3	0.3	0.28	0.28	0.27	0.28	0.3	0.3	0.31	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 2			3.21	x1/[1/(1.2)+ 0.04]		=	3.68			(27)
Windows Type 3			1.56	x1/[1/(1.2)+ 0.04]		=	1.79			(27)
Rooflights Type 1			1.38	x1/[1/(1.2) + 0.04]		=	1.656			(27b)
Rooflights Type 2			1.32	x1/[1/(1.2) + 0.04]		=	1.584			(27b)
Floor			16.84	x	0.12	=	2.0208			(28)
Walls Type1	58.24	3.12	55.12	x	0.12	=	6.61			(29)
Walls Type2	30.56	1.98	28.58	x	0.12	=	3.31			(29)
Walls Type3	63.68	0	63.68	x	0.12	=	7.64			(29)
Walls Type4	21.95	16.57	5.38	x	0.2	=	1.08			(29)
Roof Type1	110.25	2.7	107.55	x	0.12	=	12.91			(30)
Roof Type2	6.05	0	6.05	x	0.15	=	0.91			(30)
Total area of elements, m²			307.57							(31)
Party wall			19.63	x	0	=	0			(32)
Party floor			121.58							(32a)
Party ceiling			14.48							(32b)

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** 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) =	62.88	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	15227.24	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		46.14	(36)

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

Total fabric heat loss	(33) + (36) =	109.02	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.26	38.81	38.36	36.1	35.65	33.39	33.39	32.93	34.29	35.65	36.55	37.45	(38)

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

(39)m=	148.28	147.83	147.37	145.11	144.66	142.4	142.4	141.95	143.31	144.66	145.57	146.47	

Average = Sum(39)$_{1 \ldots 12}$ /12= 145 (39)

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

(40)m=	1.01	1.01	1.01	0.99	0.99	0.97	0.97	0.97	0.98	0.99	1	1	

Average = Sum(40)$_{1 \ldots 12}$ /12= 0.99 (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 2.93 (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) + 36 103.74 (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=	114.11	109.96	105.81	101.66	97.51	93.36	93.36	97.51	101.66	105.81	109.96	114.11	

Total = Sum(44)$_{1 \ldots 12}$ = 1244.85 (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=	169.22	148	152.73	133.15	127.76	110.25	102.16	117.23	118.63	138.25	150.92	163.88	

Total = Sum(45)$_{1 \ldots 12}$ = 1632.19 (45)

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

(46)m=	25.38	22.2	22.91	19.97	19.16	16.54	15.32	17.58	17.79	20.74	22.64	24.58	(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)

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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	49.69	46.04	47.58	49.69	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=	220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84	(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=	220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84

Output from water heater (annual)$_{1 \ldots 12}$ — 2223.01 (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=	69.01	60.72	63.52	56.6	54.9	48.17	45.86	51.4	51.77	58.71	62.51	67.23	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	(66)

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

(67)m=	29.4	26.12	21.24	16.08	12.02	10.15	10.96	14.25	19.13	24.29	28.35	30.22	(67)

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

(68)m=	316.24	319.52	311.25	293.64	271.42	250.54	236.58	233.3	241.57	259.17	281.4	302.28	(68)

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

(69)m=	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	(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=	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	(71)

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Water heating gains (Table 5)

(72)m=	92.75	90.35	85.38	78.61	73.8	66.9	61.64	69.09	71.91	78.91	86.82	90.36	(72)

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

(73)m=	508.31	505.91	487.78	458.26	427.15	397.5	379.11	386.56	402.53	432.29	466.48	492.79	(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	1.56	x	11.28	x	0.5	x	0.7	=	8.54	(75)
Northeast	0.9x	0.77	x	1.56	x	22.97	x	0.5	x	0.7	=	17.38	(75)
Northeast	0.9x	0.77	x	1.56	x	41.38	x	0.5	x	0.7	=	31.31	(75)
Northeast	0.9x	0.77	x	1.56	x	67.96	x	0.5	x	0.7	=	51.43	(75)
Northeast	0.9x	0.77	x	1.56	x	91.35	x	0.5	x	0.7	=	69.13	(75)
Northeast	0.9x	0.77	x	1.56	x	97.38	x	0.5	x	0.7	=	73.7	(75)
Northeast	0.9x	0.77	x	1.56	x	91.1	x	0.5	x	0.7	=	68.94	(75)
Northeast	0.9x	0.77	x	1.56	x	72.63	x	0.5	x	0.7	=	54.96	(75)
Northeast	0.9x	0.77	x	1.56	x	50.42	x	0.5	x	0.7	=	38.16	(75)
Northeast	0.9x	0.77	x	1.56	x	28.07	x	0.5	x	0.7	=	21.24	(75)
Northeast	0.9x	0.77	x	1.56	x	14.2	x	0.5	x	0.7	=	10.74	(75)
Northeast	0.9x	0.77	x	1.56	x	9.21	x	0.5	x	0.7	=	6.97	(75)
Southeast	0.9x	0.77	x	1.45	x	36.79	x	0.5	x	0.7	=	90.58	(77)
Southeast	0.9x	0.77	x	1.45	x	62.67	x	0.5	x	0.7	=	154.29	(77)
Southeast	0.9x	0.77	x	1.45	x	85.75	x	0.5	x	0.7	=	211.11	(77)
Southeast	0.9x	0.77	x	1.45	x	106.25	x	0.5	x	0.7	=	261.58	(77)
Southeast	0.9x	0.77	x	1.45	x	119.01	x	0.5	x	0.7	=	292.99	(77)
Southeast	0.9x	0.77	x	1.45	x	118.15	x	0.5	x	0.7	=	290.87	(77)
Southeast	0.9x	0.77	x	1.45	x	113.91	x	0.5	x	0.7	=	280.43	(77)
Southeast	0.9x	0.77	x	1.45	x	104.39	x	0.5	x	0.7	=	257	(77)
Southeast	0.9x	0.77	x	1.45	x	92.85	x	0.5	x	0.7	=	228.59	(77)
Southeast	0.9x	0.77	x	1.45	x	69.27	x	0.5	x	0.7	=	170.53	(77)
Southeast	0.9x	0.77	x	1.45	x	44.07	x	0.5	x	0.7	=	108.5	(77)
Southeast	0.9x	0.77	x	1.45	x	31.49	x	0.5	x	0.7	=	77.52	(77)
Northwest	0.9x	0.77	x	3.21	x	11.28	x	0.5	x	0.7	=	17.57	(81)
Northwest	0.9x	0.77	x	3.21	x	22.97	x	0.5	x	0.7	=	35.76	(81)
Northwest	0.9x	0.77	x	3.21	x	41.38	x	0.5	x	0.7	=	64.43	(81)
Northwest	0.9x	0.77	x	3.21	x	67.96	x	0.5	x	0.7	=	105.82	(81)
Northwest	0.9x	0.77	x	3.21	x	91.35	x	0.5	x	0.7	=	142.24	(81)
Northwest	0.9x	0.77	x	3.21	x	97.38	x	0.5	x	0.7	=	151.64	(81)
Northwest	0.9x	0.77	x	3.21	x	91.1	x	0.5	x	0.7	=	141.86	(81)
Northwest	0.9x	0.77	x	3.21	x	72.63	x	0.5	x	0.7	=	113.09	(81)

Northwest	0.9x	0.77	x	3.21	x	50.42	x	0.5	x	0.7	=	78.51	(81)
Northwest	0.9x	0.77	x	3.21	x	28.07	x	0.5	x	0.7	=	43.71	(81)
Northwest	0.9x	0.77	x	3.21	x	14.2	x	0.5	x	0.7	=	22.11	(81)
Northwest	0.9x	0.77	x	3.21	x	9.21	x	0.5	x	0.7	=	14.35	(81)
Rooflights	0.9x	1	x	1.38	x	26	x	0.5	x	0.8	=	12.92	(82)
Rooflights	0.9x	1	x	1.32	x	26	x	0.5	x	0.8	=	12.36	(82)
Rooflights	0.9x	1	x	1.38	x	54	x	0.5	x	0.8	=	26.83	(82)
Rooflights	0.9x	1	x	1.32	x	54	x	0.5	x	0.8	=	25.66	(82)
Rooflights	0.9x	1	x	1.38	x	96	x	0.5	x	0.8	=	47.69	(82)
Rooflights	0.9x	1	x	1.32	x	96	x	0.5	x	0.8	=	45.62	(82)
Rooflights	0.9x	1	x	1.38	x	150	x	0.5	x	0.8	=	74.52	(82)
Rooflights	0.9x	1	x	1.32	x	150	x	0.5	x	0.8	=	71.28	(82)
Rooflights	0.9x	1	x	1.38	x	192	x	0.5	x	0.8	=	95.39	(82)
Rooflights	0.9x	1	x	1.32	x	192	x	0.5	x	0.8	=	91.24	(82)
Rooflights	0.9x	1	x	1.38	x	200	x	0.5	x	0.8	=	99.36	(82)
Rooflights	0.9x	1	x	1.32	x	200	x	0.5	x	0.8	=	95.04	(82)
Rooflights	0.9x	1	x	1.38	x	189	x	0.5	x	0.8	=	93.9	(82)
Rooflights	0.9x	1	x	1.32	x	189	x	0.5	x	0.8	=	89.81	(82)
Rooflights	0.9x	1	x	1.38	x	157	x	0.5	x	0.8	=	78	(82)
Rooflights	0.9x	1	x	1.32	x	157	x	0.5	x	0.8	=	74.61	(82)
Rooflights	0.9x	1	x	1.38	x	115	x	0.5	x	0.8	=	57.13	(82)
Rooflights	0.9x	1	x	1.32	x	115	x	0.5	x	0.8	=	54.65	(82)
Rooflights	0.9x	1	x	1.38	x	66	x	0.5	x	0.8	=	32.79	(82)
Rooflights	0.9x	1	x	1.32	x	66	x	0.5	x	0.8	=	31.36	(82)
Rooflights	0.9x	1	x	1.38	x	33	x	0.5	x	0.8	=	16.39	(82)
Rooflights	0.9x	1	x	1.32	x	33	x	0.5	x	0.8	=	15.68	(82)
Rooflights	0.9x	1	x	1.38	x	21	x	0.5	x	0.8	=	10.43	(82)
Rooflights	0.9x	1	x	1.32	x	21	x	0.5	x	0.8	=	9.98	(82)

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

(83)m=	141.96	259.93	400.17	564.62	690.98	710.61	674.94	577.65	457.04	299.63	173.42	119.25	(83)

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

(84)m=	650.27	765.83	887.96	1022.88	1118.14	1108.11	1054.05	964.22	859.57	731.92	639.9	612.04	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.95	0.9	0.81	0.67	0.53	0.59	0.79	0.93	0.97	0.99	(86)

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

(87)m=	18.64	18.9	19.34	19.92	20.42	20.78	20.92	20.89	20.6	19.93	19.19	18.61	(87)

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

(88)m=	20.07	20.07	20.08	20.09	20.09	20.1	20.1	20.11	20.1	20.09	20.09	20.08	(88)

DER WorkSheet: New dwelling design stage

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

(89)m=	0.98	0.97	0.94	0.88	0.77	0.6	0.44	0.5	0.74	0.92	0.97	0.98	(89)

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

(90)m=	16.87	17.25	17.88	18.72	19.42	19.89	20.04	20.02	19.68	18.76	17.68	16.83	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	17.54	17.87	18.43	19.17	19.8	20.22	20.37	20.35	20.03	19.2	18.25	17.5	(92)

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

(93)m=	17.54	17.87	18.43	19.17	19.8	20.22	20.37	20.35	20.03	19.2	18.25	17.5	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.92	0.86	0.76	0.61	0.47	0.52	0.74	0.9	0.96	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	630.8	730.53	819.65	880.5	848.41	680.13	496.94	505.15	634.56	656.53	612.05	596.31	(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=	1963.25	1917.28	1758.2	1490.61	1171.93	800.62	537.14	560.2	849.14	1244.29	1623.27	1947.53	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.34	797.5	698.28	439.28	240.7	0	0	0	0	437.29	728.08	1005.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5337.78 (98)

Space heating requirement in kWh/m²/year 36.54 (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)													
	991.34	797.5	698.28	439.28	240.7	0	0	0	0	437.29	728.08	1005.31	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1097.83	883.17	773.29	486.47	266.56	0	0	0	0	484.27	806.29	1113.3	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5911.17 (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 design stage

Water heating

Output from water heater (calculated above)

220.18	194.03	203.69	182.47	177.45	156.29	149.74	166.92	167.95	189.21	200.23	214.84

Efficiency of water heater | 81 | (216)

(217)m=	88.45	88.32	88.02	87.36	86.1	81	81	81	81	87.27	88.12	88.51	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	248.92	219.7	231.41	208.88	206.09	192.95	184.86	206.08	207.34	216.8	227.23	242.73

Total = Sum(219a)$_{1...12}$ = | 2593 | (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5911.17	
Water heating fuel used		2593	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	395.45		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a) (230g) =		425.45	(231)
Electricity for lighting		519.29	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1276.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	560.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1836.9	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	220.81	(267)
Electricity for lighting	(232) x	0.519	=	269.51	(268)
Total CO2, kg/year		sum of (265) (271) =		2327.22	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.93	(273)
EI rating (section 14)				84	(274)

Appendix B
Energy Assessment
51 Calthorpe Street

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Be Green Residential – DER from the Be Green scenario DER SAP worksheet

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 01-Green

Address : Flat 01, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.6	(1a) x	2.7	(2a) =	193.32	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	193.32	(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) =	0.34	(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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	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=	0.6	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			3	x	1.6	=	4.8			(26)
Windows Type 1			2.36	x1/[1/(1.6)+ 0.04]		=	3.55			(27)
Windows Type 2			1.93	x1/[1/(1.6)+ 0.04]		=	2.9			(27)
Windows Type 3			1.8	x1/[1/(1.6)+ 0.04]		=	2.71			(27)
Floor			71.6	x	0.12	=	8.592			(28)
Walls Type1	52.87	13.38	39.49	x	0.23	=	9.08			(29)
Walls Type2	32.34	0	32.34	x	0.12	=	3.74			(29)
Total area of elements, m²			156.81							(31)
Party wall			20.9	x	0	=	0			(32)
Party ceiling			71.6							(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) = 41.83 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16100.47 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 23.52 (36)

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

Total fabric heat loss (33) + (36) = 65.35 (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

DER WorkSheet: New dwelling design stage

(38)m=	38.05	37.81	37.58	36.48	36.27	35.31	35.31	35.14	35.68	36.27	36.69	37.12	(38)

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

(39)m=	103.4	103.16	102.92	101.82	101.62	100.66	100.66	100.48	101.03	101.62	102.03	102.47	

Average = Sum(39)$_{1...12}$ /12= 101.82 (39)

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

(40)m=	1.44	1.44	1.44	1.42	1.42	1.41	1.41	1.4	1.41	1.42	1.43	1.43	

Average = Sum(40)$_{1...12}$ /12= 1.42 (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 2.28 (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 88.45 (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=	97.3	93.76	90.22	86.68	83.15	79.61	79.61	83.15	86.68	90.22	93.76	97.3	

Total = Sum(44)$_{1...12}$ = 1061.44 (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=	144.29	126.2	130.22	113.53	108.94	94	87.11	99.96	101.15	117.88	128.68	139.74	

Total = Sum(45)$_{1...12}$ = 1391.71 (45)

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

(46)m=	21.64	18.93	19.53	17.03	16.34	14.1	13.07	14.99	15.17	17.68	19.3	20.96	(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)

DER 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=	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=	199.57	176.12	185.5	167.03	164.21	147.5	142.39	155.24	154.65	173.16	182.17	195.01	(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=	199.57	176.12	185.5	167.03	164.21	147.5	142.39	155.24	154.65	173.16	182.17	195.01	

Output from water heater (annual)1 12 | 2042.55 | (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=	92.2	81.9	87.52	80.54	80.44	74.05	73.19	77.46	76.43	83.42	85.58	90.68	(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=	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	114.22	(66)

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

(67)m=	19.08	16.95	13.78	10.43	7.8	6.58	7.11	9.25	12.41	15.76	18.4	19.61	(67)

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

(68)m=	201	203.09	197.83	186.64	172.52	159.24	150.37	148.29	153.54	164.73	178.86	192.13	(68)

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

(69)m=	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	34.42	(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=	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	-91.37	(71)

Water heating gains (Table 5)

(72)m=	123.92	121.88	117.64	111.87	108.12	102.85	98.37	104.11	106.15	112.12	118.86	121.89	(72)

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

(73)m=	401.27	399.18	386.51	366.21	345.7	325.94	313.12	318.91	329.37	349.88	373.38	390.9	(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)	
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	53.07	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	90.41	(77)

Southeast	0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	123.7	(77)
Southeast	0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	153.27	(77)
Southeast	0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	171.67	(77)
Southeast	0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	170.43	(77)
Southeast	0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	164.31	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	150.58	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	133.94	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	99.92	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	63.57	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	45.42	(77)
Southwest	0.9x	0.77	x	1.8	x	36.79		0.63	x	0.7	=	20.24	(79)
Southwest	0.9x	0.77	x	1.8	x	62.67		0.63	x	0.7	=	34.48	(79)
Southwest	0.9x	0.77	x	1.8	x	85.75		0.63	x	0.7	=	47.17	(79)
Southwest	0.9x	0.77	x	1.8	x	106.25		0.63	x	0.7	=	58.45	(79)
Southwest	0.9x	0.77	x	1.8	x	119.01		0.63	x	0.7	=	65.47	(79)
Southwest	0.9x	0.77	x	1.8	x	118.15		0.63	x	0.7	=	64.99	(79)
Southwest	0.9x	0.77	x	1.8	x	113.91		0.63	x	0.7	=	62.66	(79)
Southwest	0.9x	0.77	x	1.8	x	104.39		0.63	x	0.7	=	57.43	(79)
Southwest	0.9x	0.77	x	1.8	x	92.85		0.63	x	0.7	=	51.08	(79)
Southwest	0.9x	0.77	x	1.8	x	69.27		0.63	x	0.7	=	38.1	(79)
Southwest	0.9x	0.77	x	1.8	x	44.07		0.63	x	0.7	=	24.24	(79)
Southwest	0.9x	0.77	x	1.8	x	31.49		0.63	x	0.7	=	17.32	(79)
Northwest	0.9x	0.77	x	1.93	x	11.28	x	0.63	x	0.7	=	13.31	(81)
Northwest	0.9x	0.77	x	1.93	x	22.97	x	0.63	x	0.7	=	27.09	(81)
Northwest	0.9x	0.77	x	1.93	x	41.38	x	0.63	x	0.7	=	48.81	(81)
Northwest	0.9x	0.77	x	1.93	x	67.96	x	0.63	x	0.7	=	80.17	(81)
Northwest	0.9x	0.77	x	1.93	x	91.35	x	0.63	x	0.7	=	107.76	(81)
Northwest	0.9x	0.77	x	1.93	x	97.38	x	0.63	x	0.7	=	114.88	(81)
Northwest	0.9x	0.77	x	1.93	x	91.1	x	0.63	x	0.7	=	107.47	(81)
Northwest	0.9x	0.77	x	1.93	x	72.63	x	0.63	x	0.7	=	85.68	(81)
Northwest	0.9x	0.77	x	1.93	x	50.42	x	0.63	x	0.7	=	59.48	(81)
Northwest	0.9x	0.77	x	1.93	x	28.07	x	0.63	x	0.7	=	33.11	(81)
Northwest	0.9x	0.77	x	1.93	x	14.2	x	0.63	x	0.7	=	16.75	(81)
Northwest	0.9x	0.77	x	1.93	x	9.21	x	0.63	x	0.7	=	10.87	(81)

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

(83)m=	86.63	151.98	219.68	291.88	344.9	350.31	334.44	293.68	244.5	171.13	104.56	73.61	(83)

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

(84)m=	487.89	551.15	606.2	658.09	690.6	676.25	647.56	612.59	573.87	521.01	477.94	464.51	(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	0.99	0.97	0.91	0.79	0.64	0.68	0.88	0.97	0.99	1	(86)

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

(87)m=	19.46	19.61	19.89	20.26	20.61	20.86	20.96	20.95	20.76	20.31	19.82	19.43	(87)

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

(88)m=	19.73	19.73	19.73	19.75	19.75	19.76	19.76	19.76	19.75	19.75	19.74	19.74	(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	0.53	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=	17.71	17.94	18.33	18.87	19.35	19.66	19.74	19.74	19.56	18.96	18.25	17.68	(90)

fLA = Living area ÷ (4) = 0.32 (91)

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

(92)m=	18.27	18.48	18.84	19.32	19.76	20.05	20.14	20.13	19.95	19.4	18.76	18.25	(92)

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

(93)m=	18.27	18.48	18.84	19.32	19.76	20.05	20.14	20.13	19.95	19.4	18.76	18.25	(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	0.87	0.72	0.53	0.58	0.82	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	484.52	544.54	591.92	622.47	602.25	485.81	343.41	355.82	471.89	497.93	471.96	461.88	(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=	1444.89	1401.06	1269.87	1061.12	819.06	548.96	356.28	374.84	590.88	894.4	1189.77	1439.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	714.51	575.58	504.39	315.83	161.31	0	0	0	0	294.97	516.83	727.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3810.53 (98)

Space heating requirement in kWh/m²/year 53.22 (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			3810.53	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =		4001.06	(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			2042.55	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =		1715.74	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =		428.94	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =		40.01	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =		21.45	(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			0	(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) =		0	(331)
Energy for lighting (calculated in Appendix L)			336.96	(332)

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			290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	716.05	(367)
Electrical energy for heat distribution	[(313) x		0.52 =	20.77	(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			290	(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 =	307.06	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	222.62	(368)
Electrical energy for heat distribution	[(313) x		0.52 =	11.13	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)		=	1277.62	(373)
CO2 associated with space heating (secondary)	(309) x		0 =	0	(374)

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CO_2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO_2 associated with space and water heating	(373) + (374) + (375) =			1277.62	(376)
CO_2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO_2 associated with electricity for lighting	(332))) x	0.52	=	174.88	(379)
Total CO_2, kg/year	sum of (376) (382) =			1452.51	(383)
Dwelling CO_2 Emission Rate	(383) ÷ (4) =			20.29	(384)
EI rating (section 14)				83.31	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 02-Green

Address : Flat 02, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	68.42	(1a) x	3.13	(2a) =	214.15	(3a)
First floor	29.89	(1b) x	2.2	(2b) =	65.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.31	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	279.91	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.11	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(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) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.39	0.38	0.37	0.33	0.33	0.29	0.29	0.28	0.3	0.33	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

(25)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1.4	=	2.772			(26)
Windows Type 1			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 2			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 3			2.55	x1/[1/(1.6)+ 0.04]		=	3.83			(27)
Windows Type 4			2.34	x1/[1/(1.6)+ 0.04]		=	3.52			(27)
Windows Type 5			0.81	x1/[1/(1.6)+ 0.04]		=	1.22			(27)
Windows Type 6			0.74	x1/[1/(1.6)+ 0.04]		=	1.11			(27)
Windows Type 7			2.49	x1/[1/(1.6)+ 0.04]		=	3.74			(27)
Floor			18.51	x	0.12	=	2.2212			(28)
Walls Type1	60.8	13.01	47.79	x	0.23	=	10.99			(29)
Walls Type2	29.23	1.98	27.25	x	0.12	=	3.15			(29)
Walls Type3	2.83	0	2.83	x	0.12	=	0.34			(29)
Roof	20.68	0	20.68	x	0.1	=	2.07			(30)
Total area of elements, m²			132.05							(31)
Party wall			92.15	x	0	=	0			(32)
Party floor			49.91							(32a)
Party ceiling			47.74							(32b)

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** 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) =	41.11	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	13532.85	(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		19.81	(36)

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

Total fabric heat loss	(33) + (36) =	60.92	(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=	53.11	52.84	52.57	51.34	51.11	50.03	50.03	49.83	50.44	51.11	51.57	52.06	(38)

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

(39)m=	114.02	113.75	113.49	112.25	112.02	110.94	110.94	110.74	111.36	112.02	112.49	112.98	

Average = Sum(39)1…12 /12= 112.25 (39)

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

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

Average = Sum(40)1…12 /12= 1.14 (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 2.72 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.88 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

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

(44)m=	108.77	104.81	100.86	96.9	92.95	88.99	88.99	92.95	96.9	100.86	104.81	108.77

Total = Sum(44)1…12 = 1186.55 (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=	161.3	141.07	145.57	126.91	121.78	105.08	97.38	111.74	113.08	131.78	143.85	156.21

Total = Sum(45)1…12 = 1555.75 (45)

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

(46)m=	24.19	21.16	21.84	19.04	18.27	15.76	14.61	16.76	16.96	19.77	21.58	23.43	(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)

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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=	216.57	191	200.85	180.41	177.05	158.58	152.65	167.02	166.57	187.06	197.34	211.49	(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=	216.57	191	200.85	180.41	177.05	158.58	152.65	167.02	166.57	187.06	197.34	211.49

Output from water heater (annual)1 12 — 2206.59 (64)

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

(65)m=	97.85	86.85	92.62	84.99	84.71	77.74	76.6	81.38	80.39	88.04	90.62	96.16	(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=	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	136.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.55	21.81	17.74	13.43	10.04	8.47	9.16	11.9	15.97	20.28	23.67	25.24	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	253.57	256.2	249.57	235.45	217.63	200.89	189.7	187.07	193.7	207.81	225.63	242.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	36.62	(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=	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	-108.93	(71)

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Water heating gains (Table 5)

(72)m=	131.52	129.24	124.5	118.05	113.86	107.97	102.96	109.38	111.66	118.33	125.87	129.25	(72)

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

(73)m=	473.49	471.09	455.65	430.78	405.38	381.18	365.66	372.19	385.18	410.28	439.02	460.71	(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)	
Southeast 0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast 0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast 0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast 0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast 0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast 0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast 0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast 0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast 0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast 0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast 0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast 0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast 0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast 0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast 0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast 0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast 0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast 0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast 0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast 0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast 0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast 0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast 0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Southeast 0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southwest 0.9x	0.77	x	2.49	x	36.79		0.63	x	0.7	=	28	(79)
Southwest 0.9x	0.77	x	2.49	x	62.67		0.63	x	0.7	=	47.69	(79)
Southwest 0.9x	0.77	x	2.49	x	85.75		0.63	x	0.7	=	65.26	(79)
Southwest 0.9x	0.77	x	2.49	x	106.25		0.63	x	0.7	=	80.85	(79)
Southwest 0.9x	0.77	x	2.49	x	119.01		0.63	x	0.7	=	90.56	(79)
Southwest 0.9x	0.77	x	2.49	x	118.15		0.63	x	0.7	=	89.91	(79)
Southwest 0.9x	0.77	x	2.49	x	113.91		0.63	x	0.7	=	86.68	(79)
Southwest 0.9x	0.77	x	2.49	x	104.39		0.63	x	0.7	=	79.44	(79)

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Southwest	0.9x	0.77	x	2.49	x	92.85		0.63	x	0.7	=	70.66	(79)
Southwest	0.9x	0.77	x	2.49	x	69.27		0.63	x	0.7	=	52.71	(79)
Southwest	0.9x	0.77	x	2.49	x	44.07		0.63	x	0.7	=	33.54	(79)
Southwest	0.9x	0.77	x	2.49	x	31.49		0.63	x	0.7	=	23.96	(79)
Northwest	0.9x	0.77	x	2.55	x	11.28	x	0.63	x	0.7	=	8.79	(81)
Northwest	0.9x	0.77	x	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(81)
Northwest	0.9x	0.77	x	0.81	x	11.28	x	0.63	x	0.7	=	2.79	(81)
Northwest	0.9x	0.77	x	0.74	x	11.28	x	0.63	x	0.7	=	2.55	(81)
Northwest	0.9x	0.77	x	2.55	x	22.97	x	0.63	x	0.7	=	17.9	(81)
Northwest	0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	0.81	x	22.97	x	0.63	x	0.7	=	5.69	(81)
Northwest	0.9x	0.77	x	0.74	x	22.97	x	0.63	x	0.7	=	5.19	(81)
Northwest	0.9x	0.77	x	2.55	x	41.38	x	0.63	x	0.7	=	32.25	(81)
Northwest	0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(81)
Northwest	0.9x	0.77	x	0.81	x	41.38	x	0.63	x	0.7	=	10.24	(81)
Northwest	0.9x	0.77	x	0.74	x	41.38	x	0.63	x	0.7	=	9.36	(81)
Northwest	0.9x	0.77	x	2.55	x	67.96	x	0.63	x	0.7	=	52.96	(81)
Northwest	0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(81)
Northwest	0.9x	0.77	x	0.81	x	67.96	x	0.63	x	0.7	=	16.82	(81)
Northwest	0.9x	0.77	x	0.74	x	67.96	x	0.63	x	0.7	=	15.37	(81)
Northwest	0.9x	0.77	x	2.55	x	91.35	x	0.63	x	0.7	=	71.19	(81)
Northwest	0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(81)
Northwest	0.9x	0.77	x	0.81	x	91.35	x	0.63	x	0.7	=	22.61	(81)
Northwest	0.9x	0.77	x	0.74	x	91.35	x	0.63	x	0.7	=	20.66	(81)
Northwest	0.9x	0.77	x	2.55	x	97.38	x	0.63	x	0.7	=	75.89	(81)
Northwest	0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(81)
Northwest	0.9x	0.77	x	0.81	x	97.38	x	0.63	x	0.7	=	24.11	(81)
Northwest	0.9x	0.77	x	0.74	x	97.38	x	0.63	x	0.7	=	22.02	(81)
Northwest	0.9x	0.77	x	2.55	x	91.1	x	0.63	x	0.7	=	71	(81)
Northwest	0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(81)
Northwest	0.9x	0.77	x	0.81	x	91.1	x	0.63	x	0.7	=	22.55	(81)
Northwest	0.9x	0.77	x	0.74	x	91.1	x	0.63	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	2.55	x	72.63	x	0.63	x	0.7	=	56.6	(81)
Northwest	0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(81)
Northwest	0.9x	0.77	x	0.81	x	72.63	x	0.63	x	0.7	=	17.98	(81)
Northwest	0.9x	0.77	x	0.74	x	72.63	x	0.63	x	0.7	=	16.42	(81)
Northwest	0.9x	0.77	x	2.55	x	50.42	x	0.63	x	0.7	=	39.29	(81)
Northwest	0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(81)
Northwest	0.9x	0.77	x	0.81	x	50.42	x	0.63	x	0.7	=	12.48	(81)
Northwest	0.9x	0.77	x	0.74	x	50.42	x	0.63	x	0.7	=	11.4	(81)
Northwest	0.9x	0.77	x	2.55	x	28.07	x	0.63	x	0.7	=	21.87	(81)

Northwest 0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(81)
Northwest 0.9x	0.77	x	0.81	x	28.07	x	0.63	x	0.7	=	6.95	(81)
Northwest 0.9x	0.77	x	0.74	x	28.07	x	0.63	x	0.7	=	6.35	(81)
Northwest 0.9x	0.77	x	2.55	x	14.2	x	0.63	x	0.7	=	11.06	(81)
Northwest 0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(81)
Northwest 0.9x	0.77	x	0.81	x	14.2	x	0.63	x	0.7	=	3.51	(81)
Northwest 0.9x	0.77	x	0.74	x	14.2	x	0.63	x	0.7	=	3.21	(81)
Northwest 0.9x	0.77	x	2.55	x	9.21	x	0.63	x	0.7	=	7.18	(81)
Northwest 0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(81)
Northwest 0.9x	0.77	x	0.81	x	9.21	x	0.63	x	0.7	=	2.28	(81)
Northwest 0.9x	0.77	x	0.74	x	9.21	x	0.63	x	0.7	=	2.08	(81)

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

(83)m=	96.08	171.04	253.62	347.09	418.74	428.9	408.02	352.54	285.67	194.32	116.43	81.36	(83)

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

(84)m=	569.58	642.14	709.27	777.86	824.12	810.07	773.68	724.74	670.85	604.6	555.45	542.07	(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	0.97	0.92	0.78	0.61	0.66	0.89	0.98	1	1	(86)

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

(87)m=	19.73	19.86	20.1	20.43	20.73	20.92	20.98	20.97	20.83	20.45	20.03	19.7	(87)

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

(88)m=	19.95	19.95	19.96	19.97	19.97	19.98	19.98	19.98	19.97	19.97	19.96	19.96	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.54	0.83	0.97	1	1	(89)

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

(90)m=	18.25	18.45	18.8	19.28	19.69	19.92	19.97	19.97	19.83	19.32	18.71	18.23	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.74	18.92	19.23	19.65	20.03	20.25	20.3	20.3	20.16	19.7	19.15	18.71	(92)

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

(93)m=	18.74	18.92	19.23	19.65	20.03	20.25	20.3	20.3	20.16	19.7	19.15	18.71	(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	0.96	0.88	0.71	0.52	0.58	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	567.71	638.06	698.9	745.61	727.09	578.57	403.19	418.88	562.43	586.32	551.8	540.68	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1646.4	1594.75	1444.74	1207.24	933.06	627.11	411	431.8	675.18	1018.88	1355.3	1639.75	(97)

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

(98)m=	802.54	642.89	554.91	332.37	153.24	0	0	0	0	321.82	578.52	817.7

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4204 (98)

Space heating requirement in kWh/m²/year 42.76 (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		4204	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	4414.2	(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		2206.59	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1853.54	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	463.38	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	44.14	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	23.17	(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		0	(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) =	0	(331)

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Energy for lighting (calculated in Appendix L)				433.62	(332)

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			290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	789.99	(367)
Electrical energy for heat distribution	[(313) x		0.52 =	22.91	(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			290	(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 =	331.72	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	240.5	(368)
Electrical energy for heat distribution	[(313) x		0.52 =	12.02	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)		=	1397.14	(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) =			1397.14	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52 =	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52 =	225.05	(379)
Total CO2, kg/year	sum of (376) (382) =			1622.18	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.5	(384)
EI rating (section 14)				84.83	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 03-Green

Address : Flat 03, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.13	(1a)	x	3.33	(2a)	=	186.91	(3a)
First floor	45.8	(1b)	x	2.2	(2b)	=	100.76	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	101.93	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	287.67	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.1	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.35	0.34	0.34	0.3	0.3	0.26	0.26	0.25	0.27	0.3	0.31	0.32

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=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			2.64		x1/[1/(1.6)+ 0.04]	=	3.97			(27)
Windows Type 2			2.28		x1/[1/(1.6)+ 0.04]	=	3.43			(27)
Windows Type 3			2.34		x1/[1/(1.6)+ 0.04]	=	3.52			(27)
Floor			59.1	x	0.12	=	7.092			(28)
Walls Type1	70.52	12.54	57.98	x	0.23	=	13.34			(29)
Walls Type2	33.65	1.98	31.67	x	0.12	=	3.66			(29)
Roof	20.55	0	20.55	x	0.1	=	2.05			(30)
Total area of elements, m²			183.82							(31)
Party wall			51.98	x	0	=	0			(32)
Party floor			5.32							(32a)
Party ceiling			43.87							(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) = 47.78 (33)

Heat capacity Cm = S(A x k) ((28) (30) + (32) + (32a) (32e) = 13345 (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 | 27.57 | (36)

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

Total fabric heat loss (33) + (36) = | 75.35 | (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=	53.28	53.06	52.84	51.8	51.6	50.7	50.7	50.53	51.04	51.6	51.99	52.41	(38)

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

(39)m=	128.63	128.41	128.18	127.14	126.95	126.04	126.04	125.88	126.39	126.95	127.34	127.76	

Average = Sum(39)$_{1...12}$ /12= | 127.14 | (39)

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

(40)m=	1.26	1.26	1.26	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.25	1.25

Average = Sum(40)$_{1...12}$ /12= | 1.25 | (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 | 2.76 | (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 | 99.67 | (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=	109.64	105.65	101.66	97.68	93.69	89.7	89.7	93.69	97.68	101.66	105.65	109.64

Total = Sum(44)$_{1...12}$ = | 1196.06 | (44)

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

(45)m=	162.59	142.2	146.74	127.93	122.75	105.93	98.16	112.64	113.98	132.84	145	157.46

Total = Sum(45)$_{1...12}$ = | 1568.22 | (45)

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

(46)m=	24.39	21.33	22.01	19.19	18.41	15.89	14.72	16.9	17.1	19.93	21.75	23.62	(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)

DER WorkSheet: New dwelling design stage

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=	217.87	192.13	202.02	181.43	178.03	159.42	153.43	167.91	167.48	188.11	198.49	212.74	(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=	217.87	192.13	202.02	181.43	178.03	159.42	153.43	167.91	167.48	188.11	198.49	212.74	

Output from water heater (annual)$_{1\ \ 12}$ | 2219.06 | (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=	98.28	87.22	93.01	85.33	85.04	78.02	76.86	81.67	80.69	88.39	91.01	96.58	(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=	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	137.83	(66)

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

(67)m=	25.53	22.67	18.44	13.96	10.44	8.81	9.52	12.37	16.61	21.09	24.61	26.24	(67)

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

(68)m=	259.41	262.1	255.32	240.88	222.65	205.52	194.07	191.38	198.16	212.6	230.83	247.96	(68)

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

(69)m=	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	(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=	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	-110.27	(71)

Water heating gains (Table 5)

(72)m=	132.1	129.8	125.02	118.52	114.3	108.36	103.3	109.78	112.07	118.8	126.4	129.81	(72)

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

(73)m=	481.39	478.93	463.13	437.71	411.73	387.03	371.24	377.88	391.19	416.84	446.19	468.36	(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	2.34	x	11.28	x	0.63	x	0.7	=	8.07	(75)
Northeast	0.9x	0.77	x	2.34	x	22.97	x	0.63	x	0.7	=	16.42	(75)
Northeast	0.9x	0.77	x	2.34	x	41.38	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	2.34	x	67.96	x	0.63	x	0.7	=	48.6	(75)
Northeast	0.9x	0.77	x	2.34	x	91.35	x	0.63	x	0.7	=	65.32	(75)
Northeast	0.9x	0.77	x	2.34	x	97.38	x	0.63	x	0.7	=	69.64	(75)
Northeast	0.9x	0.77	x	2.34	x	91.1	x	0.63	x	0.7	=	65.15	(75)
Northeast	0.9x	0.77	x	2.34	x	72.63	x	0.63	x	0.7	=	51.94	(75)
Northeast	0.9x	0.77	x	2.34	x	50.42	x	0.63	x	0.7	=	36.06	(75)
Northeast	0.9x	0.77	x	2.34	x	28.07	x	0.63	x	0.7	=	20.07	(75)
Northeast	0.9x	0.77	x	2.34	x	14.2	x	0.63	x	0.7	=	10.15	(75)
Northeast	0.9x	0.77	x	2.34	x	9.21	x	0.63	x	0.7	=	6.59	(75)
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	89.06	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	151.7	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	207.56	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	257.18	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	288.06	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	285.98	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	275.71	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	252.67	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	224.74	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	167.66	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	106.67	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	76.21	(77)
Southwest	0.9x	0.77	x	2.28	x	36.79		0.63	x	0.7	=	25.64	(79)
Southwest	0.9x	0.77	x	2.28	x	62.67		0.63	x	0.7	=	43.67	(79)
Southwest	0.9x	0.77	x	2.28	x	85.75		0.63	x	0.7	=	59.75	(79)
Southwest	0.9x	0.77	x	2.28	x	106.25		0.63	x	0.7	=	74.04	(79)
Southwest	0.9x	0.77	x	2.28	x	119.01		0.63	x	0.7	=	82.93	(79)
Southwest	0.9x	0.77	x	2.28	x	118.15		0.63	x	0.7	=	82.33	(79)
Southwest	0.9x	0.77	x	2.28	x	113.91		0.63	x	0.7	=	79.37	(79)
Southwest	0.9x	0.77	x	2.28	x	104.39		0.63	x	0.7	=	72.74	(79)
Southwest	0.9x	0.77	x	2.28	x	92.85		0.63	x	0.7	=	64.7	(79)
Southwest	0.9x	0.77	x	2.28	x	69.27		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.28	x	44.07		0.63	x	0.7	=	30.71	(79)
Southwest	0.9x	0.77	x	2.28	x	31.49		0.63	x	0.7	=	21.94	(79)

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

(83)m=	122.76	211.79	296.9	379.81	436.31	437.95	420.23	377.35	325.5	236	147.53	104.74	(83)

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

(84)m=	604.15	690.72	760.03	817.52	848.04	824.98	791.48	755.23	716.7	652.84	593.73	573.11	(84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.82	0.66	0.7	0.9	0.98	1	1	(86)

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

(87)m=	19.6	19.75	20	20.33	20.65	20.88	20.97	20.96	20.79	20.38	19.93	19.58	(87)

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

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.88	(88)

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

(89)m=	1	0.99	0.99	0.97	0.9	0.73	0.51	0.56	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=	18.02	18.24	18.6	19.08	19.52	19.8	19.88	19.87	19.71	19.16	18.51	17.98	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)m=	18.45	18.65	18.98	19.42	19.82	20.09	20.17	20.17	20	19.49	18.89	18.41	(92)

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

(93)m=	18.45	18.65	18.98	19.42	19.82	20.09	20.17	20.17	20	19.49	18.89	18.41	(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=	1	0.99	0.98	0.96	0.9	0.75	0.55	0.6	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	601.81	685.46	747.6	784.23	759.03	616.12	436.52	453.32	603.31	631.11	589.15	571.36	(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=	1820	1765.45	1599.59	1337.12	1031.03	692.6	450.46	474.09	746.16	1129.01	1501.77	1815.98	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	906.33	725.75	633.88	398.08	202.37	0	0	0	0	370.44	657.09	926	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4819.94 | (98)

Space heating requirement in kWh/m²/year | 47.29 | (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		4819.94	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	5060.94	(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		2219.06	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1864.01	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	466	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	50.61	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	23.3	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		450.84	(332)

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				290	(367a)
CO2 associated with heat source 1		[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	905.73	(367)
Electrical energy for heat distribution		[(313) x	0.52	=	26.27	(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				290	(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	=	333.59	(367)
CO2 associated with heat source 2		[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	241.86	(368)

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Electrical energy for heat distribution	[(313) x	0.52	=	12.09	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)		=	1519.54	(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) =			1519.54	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	233.99	(379)
Total CO2, kg/year	sum of (376) (382) =			1753.53	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.2	(384)
EI rating (section 14)				84.01	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 04-Green

Address : Flat 04, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	83.77	(1a)	x	3.06	(2a)	=	256.34	(3a)
First floor	20.32	(1b)	x	2.2	(2b)	=	44.7	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	104.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	301.04	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.98	x	1.4	=	2.772			(26)
Windows Type 1			1.44	x1/[1/(1.6)+ 0.04]		=	2.17			(27)
Windows Type 2			2.64	x1/[1/(1.6)+ 0.04]		=	3.97			(27)
Windows Type 3			0.69	x1/[1/(1.6)+ 0.04]		=	1.04			(27)
Windows Type 4			1.8	x1/[1/(1.2)+ 0.04]		=	2.06			(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 6			8.66	x1/[1/(1.2)+ 0.04]		=	9.92			(27)
Windows Type 7			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Floor			83.77	x	0.12	=	10.0524			(28)
Walls Type1	55.67	9.01	46.66	x	0.23	=	10.73			(29)
Walls Type2	19.9	1.98	17.92	x	0.12	=	2.07			(29)
Walls Type3	36.42	11.9	24.52	x	0.12	=	2.94			(29)
Roof	13.01	0	13.01	x	0.1	=	1.3			(30)
Total area of elements, m²			208.77							(31)
Party wall			58.33	x	0	=	0			(32)
Party ceiling			70.76							(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) = 57.05 (33)

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Heat capacity Cm = S(A x k) ((28) (30) + (32) + (32a) (32e) =	18376.29	(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	31.32	(36)

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

Total fabric heat loss (33) + (36) =	88.36	(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=	59.8	59.41	59.02	57.21	56.87	55.29	55.29	55	55.9	56.87	57.56	58.27	(38)

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

(39)m=	148.16	147.77	147.38	145.57	145.23	143.66	143.66	143.37	144.27	145.23	145.92	146.64	

Average = Sum(39)1…12 /12= 145.57 (39)

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

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

Average = Sum(40)1…12 /12= 1.4 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.77 (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 — 100.09 (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=	110.1	106.09	102.09	98.09	94.08	90.08	90.08	94.08	98.09	102.09	106.09	110.1	

Total = Sum(44)1…12 = 1201.08 (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=	163.27	142.8	147.36	128.47	123.27	106.37	98.57	113.11	114.46	133.39	145.61	158.12	

Total = Sum(45)1…12 = 1574.8 (45)

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

(46)m=	24.49	21.42	22.1	19.27	18.49	15.96	14.79	16.97	17.17	20.01	21.84	23.72	(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:

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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=	218.55	192.73	202.63	181.96	178.55	159.87	153.85	168.39	167.95	188.67	199.1	213.4	(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=	218.55	192.73	202.63	181.96	178.55	159.87	153.85	168.39	167.95	188.67	199.1	213.4	

Output from water heater (annual)1…12 — 2225.64 (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=	98.51	87.42	93.22	85.51	85.21	78.16	77	81.83	80.85	88.57	91.21	96.8	(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=	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)

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

(67)m=	23.58	20.94	17.03	12.9	9.64	8.14	8.79	11.43	15.34	19.48	22.73	24.24	(67)

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

(68)m=	262.78	265.5	258.63	244	225.54	208.18	196.59	193.86	200.73	215.36	233.83	251.18	(68)

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

(69)m=	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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=	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)

Water heating gains (Table 5)

(72)m=	132.41	130.09	125.29	118.77	114.53	108.56	103.49	109.99	112.3	119.05	126.68	130.1	(72)

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

(73)m=	483.38	481.15	465.57	440.28	414.32	389.49	373.48	379.89	392.98	418.51	447.86	470.13	(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	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast	0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)
Northeast	0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast	0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast	0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast	0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast	0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast	0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast	0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast	0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast	0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast	0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
East	0.9x	0.77	x	0.69	x	19.64	x	0.63	x	0.7	=	4.14	(76)
East	0.9x	0.77	x	1.8	x	19.64	x	0.5	x	0.7	=	8.57	(76)
East	0.9x	0.77	x	1.44	x	19.64	x	0.5	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	0.69	x	38.42	x	0.63	x	0.7	=	8.1	(76)
East	0.9x	0.77	x	1.8	x	38.42	x	0.5	x	0.7	=	16.77	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.5	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	0.69	x	63.27	x	0.63	x	0.7	=	13.34	(76)
East	0.9x	0.77	x	1.8	x	63.27	x	0.5	x	0.7	=	27.62	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.5	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	0.69	x	92.28	x	0.63	x	0.7	=	19.46	(76)
East	0.9x	0.77	x	1.8	x	92.28	x	0.5	x	0.7	=	40.29	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.5	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	0.69	x	113.09	x	0.63	x	0.7	=	23.85	(76)
East	0.9x	0.77	x	1.8	x	113.09	x	0.5	x	0.7	=	49.38	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.5	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	0.69	x	115.77	x	0.63	x	0.7	=	24.41	(76)
East	0.9x	0.77	x	1.8	x	115.77	x	0.5	x	0.7	=	50.54	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.5	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	0.69	x	110.22	x	0.63	x	0.7	=	23.24	(76)
East	0.9x	0.77	x	1.8	x	110.22	x	0.5	x	0.7	=	48.12	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.5	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	0.69	x	94.68	x	0.63	x	0.7	=	19.96	(76)

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East	0.9x	0.77	x	1.8	x	94.68	x	0.5	x	0.7	=	41.33	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.5	x	0.7	=	33.07	(76)
East	0.9x	0.77	x	0.69	x	73.59	x	0.63	x	0.7	=	15.52	(76)
East	0.9x	0.77	x	1.8	x	73.59	x	0.5	x	0.7	=	32.13	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.5	x	0.7	=	25.7	(76)
East	0.9x	0.77	x	0.69	x	45.59	x	0.63	x	0.7	=	9.61	(76)
East	0.9x	0.77	x	1.8	x	45.59	x	0.5	x	0.7	=	19.9	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.5	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	0.69	x	24.49	x	0.63	x	0.7	=	5.16	(76)
East	0.9x	0.77	x	1.8	x	24.49	x	0.5	x	0.7	=	10.69	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.5	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	0.69	x	16.15	x	0.63	x	0.7	=	3.41	(76)
East	0.9x	0.77	x	1.8	x	16.15	x	0.5	x	0.7	=	7.05	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.5	x	0.7	=	5.64	(76)
Southeast	0.9x	0.77	x	1.44	x	36.79	x	0.63	x	0.7	=	16.19	(77)
Southeast	0.9x	0.77	x	2.64	x	36.79	x	0.63	x	0.7	=	29.69	(77)
Southeast	0.9x	0.77	x	1.44	x	62.67	x	0.63	x	0.7	=	27.58	(77)
Southeast	0.9x	0.77	x	2.64	x	62.67	x	0.63	x	0.7	=	50.57	(77)
Southeast	0.9x	0.77	x	1.44	x	85.75	x	0.63	x	0.7	=	37.74	(77)
Southeast	0.9x	0.77	x	2.64	x	85.75	x	0.63	x	0.7	=	69.19	(77)
Southeast	0.9x	0.77	x	1.44	x	106.25	x	0.63	x	0.7	=	46.76	(77)
Southeast	0.9x	0.77	x	2.64	x	106.25	x	0.63	x	0.7	=	85.73	(77)
Southeast	0.9x	0.77	x	1.44	x	119.01	x	0.63	x	0.7	=	52.37	(77)
Southeast	0.9x	0.77	x	2.64	x	119.01	x	0.63	x	0.7	=	96.02	(77)
Southeast	0.9x	0.77	x	1.44	x	118.15	x	0.63	x	0.7	=	52	(77)
Southeast	0.9x	0.77	x	2.64	x	118.15	x	0.63	x	0.7	=	95.33	(77)
Southeast	0.9x	0.77	x	1.44	x	113.91	x	0.63	x	0.7	=	50.13	(77)
Southeast	0.9x	0.77	x	2.64	x	113.91	x	0.63	x	0.7	=	91.9	(77)
Southeast	0.9x	0.77	x	1.44	x	104.39	x	0.63	x	0.7	=	45.94	(77)
Southeast	0.9x	0.77	x	2.64	x	104.39	x	0.63	x	0.7	=	84.22	(77)
Southeast	0.9x	0.77	x	1.44	x	92.85	x	0.63	x	0.7	=	40.86	(77)
Southeast	0.9x	0.77	x	2.64	x	92.85	x	0.63	x	0.7	=	74.91	(77)
Southeast	0.9x	0.77	x	1.44	x	69.27	x	0.63	x	0.7	=	30.48	(77)
Southeast	0.9x	0.77	x	2.64	x	69.27	x	0.63	x	0.7	=	55.89	(77)
Southeast	0.9x	0.77	x	1.44	x	44.07	x	0.63	x	0.7	=	19.39	(77)
Southeast	0.9x	0.77	x	2.64	x	44.07	x	0.63	x	0.7	=	35.56	(77)
Southeast	0.9x	0.77	x	1.44	x	31.49	x	0.63	x	0.7	=	13.86	(77)
Southeast	0.9x	0.77	x	2.64	x	31.49	x	0.63	x	0.7	=	25.4	(77)
Northwest	0.9x	0.77	x	8.66	x	11.28	x	0.5	x	0.7	=	23.7	(81)
Northwest	0.9x	0.77	x	8.66	x	22.97	x	0.5	x	0.7	=	48.24	(81)
Northwest	0.9x	0.77	x	8.66	x	41.38	x	0.5	x	0.7	=	86.92	(81)

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Northwest	0.9x	0.77	x	8.66	x	67.96	x	0.5	x	0.7	=	142.74	(81)
Northwest	0.9x	0.77	x	8.66	x	91.35	x	0.5	x	0.7	=	191.87	(81)
Northwest	0.9x	0.77	x	8.66	x	97.38	x	0.5	x	0.7	=	204.55	(81)
Northwest	0.9x	0.77	x	8.66	x	91.1	x	0.5	x	0.7	=	191.36	(81)
Northwest	0.9x	0.77	x	8.66	x	72.63	x	0.5	x	0.7	=	152.55	(81)
Northwest	0.9x	0.77	x	8.66	x	50.42	x	0.5	x	0.7	=	105.91	(81)
Northwest	0.9x	0.77	x	8.66	x	28.07	x	0.5	x	0.7	=	58.95	(81)
Northwest	0.9x	0.77	x	8.66	x	14.2	x	0.5	x	0.7	=	29.82	(81)
Northwest	0.9x	0.77	x	8.66	x	9.21	x	0.5	x	0.7	=	19.35	(81)

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

(83)m=	103.77	194.44	310.53	455.26	571.35	593.46	561.3	471.19	360.37	227.13	127.58	86.65	(83)

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

(84)m=	587.15	675.6	776.1	895.54	985.67	982.95	934.78	851.08	753.35	645.64	575.43	556.79	(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	0.97	0.91	0.79	0.63	0.7	0.91	0.99	1	1	(86)

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

(87)m=	19.38	19.53	19.82	20.23	20.61	20.87	20.96	20.94	20.73	20.24	19.75	19.36	(87)

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

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

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

(89)m=	1	1	0.99	0.96	0.87	0.69	0.48	0.55	0.84	0.98	1	1	(89)

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

(90)m=	17.6	17.83	18.26	18.85	19.38	19.69	19.77	19.76	19.54	18.88	18.15	17.58	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.19	18.4	18.78	19.31	19.79	20.09	20.17	20.15	19.94	19.34	18.68	18.17	(92)

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

(93)m=	18.19	18.4	18.78	19.31	19.79	20.09	20.17	20.15	19.94	19.34	18.68	18.17	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.88	0.71	0.53	0.6	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	585.12	671.15	764.03	855.15	863.11	701.96	494.61	508.75	644.23	628	571.74	555.27	(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=	2058.68	1994.83	1809.77	1515.85	1174.72	787.97	512.16	538.04	842.42	1268.78	1690.23	2048.88	(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=	1096.33	889.51	778.03	475.7	231.84	0	0	0	0	476.74	805.31	1111.25

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5864.72 (98)

Space heating requirement in kWh/m²/year 56.34 (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		5864.72	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	6157.95	(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		2225.64	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1869.54	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	467.38	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	61.58	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	23.37	(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		0	(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) =	0	(331)
Energy for lighting (calculated in Appendix L)		416.45	(332)

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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				290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	1102.06	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	31.96	(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				290	(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	=	334.58	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	242.57	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	12.13	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)			=	1723.3	(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) =				1723.3	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	216.14	(379)
Total CO2, kg/year	sum of (376) (382) =				1939.44	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.63	(384)
EI rating (section 14)					82.57	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 05-Green

Address : Flat 05, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.09	(1a) x	2.4	(2a) =	180.22	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.09	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		180.22	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.17	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.39	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			4.24	x1/[1/(1.6)+ 0.04]		=	6.38			(27)
Windows Type 2			2.03	x1/[1/(1.6)+ 0.04]		=	3.05			(27)
Floor			75.09	x	0.12	=	9.010799			(28)
Walls Type1	52.54	8.3	44.24	x	0.23	=	10.18			(29)
Walls Type2	8.28	1.98	6.3	x	0.12	=	0.73			(29)
Roof	9.64	0	9.64	x	0.12	=	1.16			(30)
Total area of elements, m²			145.55							(31)
Party wall			40.53	x	0	=	0			(32)
Party ceiling			65.45							(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) = 36.32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16157.12 (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 21.83 (36)

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

Total fabric heat loss (33) + (36) = 58.16 (37)

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

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

(38)m=	36.91	36.63	36.36	35.08	34.84	33.72	33.72	33.51	34.15	34.84	35.32	35.83	(38)

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

(39)m=	95.07	94.79	94.52	93.23	92.99	91.88	91.88	91.67	92.31	92.99	93.48	93.99	

Average = Sum(39)1…12 /12= 93.23 (39)

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

(40)m=	1.27	1.26	1.26	1.24	1.24	1.22	1.22	1.22	1.23	1.24	1.24	1.25	

Average = Sum(40)1…12 /12= 1.24 (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 2.36 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.32 (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=	99.36	95.74	92.13	88.52	84.9	81.29	81.29	84.9	88.52	92.13	95.74	99.36	

Total = Sum(44)1…12 = 1083.89 (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=	147.34	128.87	132.98	115.93	111.24	95.99	88.95	102.07	103.29	120.38	131.4	142.69	

Total = Sum(45)1…12 = 1421.15 (45)

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

(46)m=	22.1	19.33	19.95	17.39	16.69	14.4	13.34	15.31	15.49	18.06	19.71	21.4	(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=	202.62	178.79	188.26	169.43	166.52	149.49	144.23	157.35	156.79	175.65	184.89	197.97	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	202.62	178.79	188.26	169.43	166.52	149.49	144.23	157.35	156.79	175.65	184.89	197.97

Output from water heater (annual)₁ ₁₂ | 2071.99 | (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=	93.21	82.79	88.44	81.34	81.21	74.71	73.8	78.16	77.14	84.25	86.49	91.67	(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=	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	118.16	(66)

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

(67)m=	21.05	18.69	15.2	11.51	8.6	7.26	7.85	10.2	13.69	17.38	20.29	21.63	(67)

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

(68)m=	208.87	211.04	205.58	193.95	179.27	165.48	156.26	154.1	159.56	171.18	185.86	199.66	(68)

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

(69)m=	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	34.82	(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=	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	-94.52	(71)

Water heating gains (Table 5)

(72)m=	125.29	123.2	118.87	112.98	109.15	103.77	99.19	105.05	107.14	113.24	120.12	123.21	(72)

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

(73)m=	413.65	411.38	398.1	376.88	355.48	334.96	321.75	327.8	338.83	360.25	384.72	402.94	(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	4.24	x	11.28	x	0.63	x	0.7	=	14.62	(75)
Northeast 0.9x	0.77	x	4.24	x	22.97	x	0.63	x	0.7	=	29.76	(75)

Northeast 0.9x	0.77	x	4.24	x	41.38	x	0.63	x	0.7	=	53.62	(75)
Northeast 0.9x	0.77	x	4.24	x	67.96	x	0.63	x	0.7	=	88.06	(75)
Northeast 0.9x	0.77	x	4.24	x	91.35	x	0.63	x	0.7	=	118.37	(75)
Northeast 0.9x	0.77	x	4.24	x	97.38	x	0.63	x	0.7	=	126.19	(75)
Northeast 0.9x	0.77	x	4.24	x	91.1	x	0.63	x	0.7	=	118.05	(75)
Northeast 0.9x	0.77	x	4.24	x	72.63	x	0.63	x	0.7	=	94.11	(75)
Northeast 0.9x	0.77	x	4.24	x	50.42	x	0.63	x	0.7	=	65.34	(75)
Northeast 0.9x	0.77	x	4.24	x	28.07	x	0.63	x	0.7	=	36.37	(75)
Northeast 0.9x	0.77	x	4.24	x	14.2	x	0.63	x	0.7	=	18.4	(75)
Northeast 0.9x	0.77	x	4.24	x	9.21	x	0.63	x	0.7	=	11.94	(75)
Southwest0.9x	0.77	x	2.03	x	36.79		0.63	x	0.7	=	45.65	(79)
Southwest0.9x	0.77	x	2.03	x	62.67		0.63	x	0.7	=	77.76	(79)
Southwest0.9x	0.77	x	2.03	x	85.75		0.63	x	0.7	=	106.4	(79)
Southwest0.9x	0.77	x	2.03	x	106.25		0.63	x	0.7	=	131.84	(79)
Southwest0.9x	0.77	x	2.03	x	119.01		0.63	x	0.7	=	147.67	(79)
Southwest0.9x	0.77	x	2.03	x	118.15		0.63	x	0.7	=	146.6	(79)
Southwest0.9x	0.77	x	2.03	x	113.91		0.63	x	0.7	=	141.34	(79)
Southwest0.9x	0.77	x	2.03	x	104.39		0.63	x	0.7	=	129.53	(79)
Southwest0.9x	0.77	x	2.03	x	92.85		0.63	x	0.7	=	115.21	(79)
Southwest0.9x	0.77	x	2.03	x	69.27		0.63	x	0.7	=	85.95	(79)
Southwest0.9x	0.77	x	2.03	x	44.07		0.63	x	0.7	=	54.68	(79)
Southwest0.9x	0.77	x	2.03	x	31.49		0.63	x	0.7	=	39.07	(79)

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

(83)m=	60.27	107.52	160.02	219.89	266.03	272.79	259.39	223.64	180.54	122.32	73.08	51.01	(83)

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

(84)m=	473.93	518.91	558.11	596.78	621.51	607.75	581.13	551.43	519.38	482.57	457.8	453.95	(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	0.93	0.81	0.65	0.7	0.9	0.98	1	1	(86)

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

(87)m=	19.63	19.76	20	20.33	20.65	20.88	20.97	20.96	20.79	20.39	19.96	19.62	(87)

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

(88)m=	19.87	19.87	19.87	19.89	19.89	19.9	19.9	19.9	19.9	19.89	19.88	19.88	(88)

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

(89)m=	1	0.99	0.99	0.97	0.9	0.72	0.51	0.56	0.84	0.97	0.99	1	(89)

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

(90)m=	18.06	18.25	18.59	19.08	19.52	19.82	19.89	19.88	19.72	19.18	18.55	18.04	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	18.63	18.79	19.1	19.53	19.93	20.2	20.28	20.27	20.1	19.61	19.06	18.61	(92)

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

(93)m=	18.63	18.79	19.1	19.53	19.93	20.2	20.28	20.27	20.1	19.61	19.06	18.61	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.9	0.75	0.56	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	471.66	514.81	549.43	573.95	558.96	456.99	326.82	338.18	442.6	466.95	453.77	452.17	(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=	1361.89	1316.9	1190.67	990.94	765.03	514.56	337.86	354.74	554.08	838.19	1117.84	1354.2	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	662.34	539	477.08	300.23	153.32	0	0	0	0	276.21	478.13	671.1	

Total per year (kWh/year) = Sum(98)1...5,9...12 =	3557.41	(98)
Space heating requirement in kWh/m²/year	47.38	(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		3557.41	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	3735.28	(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		2071.99	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1740.47	(310a)

Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =			435.12	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =			37.35	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =			21.76	(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				0	(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) =			0	(331)
Energy for lighting (calculated in Appendix L)				371.68	(332)

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			290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	668.49	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.39	(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			290	(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	=	311.48	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	225.83	(368)
Electrical energy for heat distribution	[(313) x	0.52	=	11.29	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)		=	1236.47	(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) =			1236.47	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	192.9	(379)
Total CO2, kg/year	sum of (376) (382) =			1429.37	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			19.04	(384)
EI rating (section 14)				84.05	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 06-Green

Address : Flat 06, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.21	(1a) x	2.2	(2a) =	117.06	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.21	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		117.06	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			4.95	x1/[1/(1.2)+ 0.04]		=	5.67			(27)
Windows Type 2			1.67	x1/[1/(1.2)+ 0.04]		=	1.91			(27)
Walls Type1	29.77	8.29	21.48	x	0.12	=	2.58			(29)
Walls Type2	11.99	1.98	10.01	x	0.12	=	1.16			(29)
Roof	38.74	0	38.74	x	0.12	=	4.65			(30)
Total area of elements, m²			80.5							(31)
Party wall			39.44	x	0	=	0			(32)
Party floor			53.21							(32a)
Party ceiling			14.48							(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) = 20.65 (33)

Heat capacity Cm = S(A x k) ((28) (30) + (32) + (32a) (32e) = 7125.67 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 12.08 (36)

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

Total fabric heat loss (33) + (36) = 32.72 (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=	10.82	10.7	10.57	9.96	9.83	9.22	9.22	9.1	9.46	9.83	10.08	10.33		(38)

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

(39)m=	43.54	43.42	43.3	42.68	42.56	41.94	41.94	41.82	42.19	42.56	42.8	43.05		
										Average = Sum(39)1…12 /12=			42.65	(39)

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

(40)m=	0.82	0.82	0.81	0.8	0.8	0.79	0.79	0.79	0.79	0.8	0.8	0.81		
										Average = Sum(40)1…12 /12=			0.8	(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 — 1.78 (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 — 76.59 (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=	84.25	81.18	78.12	75.06	71.99	68.93	68.93	71.99	75.06	78.12	81.18	84.25		
										Total = Sum(44)1…12 =			919.05	(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=	124.94	109.27	112.76	98.3	94.32	81.39	75.42	86.55	87.58	102.07	111.42	120.99		
										Total = Sum(45)1…12 =			1205.02	(45)

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

(46)m=	18.74	16.39	16.91	14.75	14.15	12.21	11.31	12.98	13.14	15.31	16.71	18.15	(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)

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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=	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=	180.21	159.2	168.03	151.8	149.6	134.89	130.7	141.83	141.08	157.35	164.91	176.27	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	180.21	159.2	168.03	151.8	149.6	134.89	130.7	141.83	141.08	157.35	164.91	176.27

Output from water heater (annual)1 12 | 1855.86 | (64)

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

(65)m=	85.76	76.27	81.71	75.48	75.58	69.86	69.3	73	71.92	78.16	79.84	84.45	(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=	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	89.24	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.55	12.92	10.51	7.95	5.95	5.02	5.42	7.05	9.46	12.02	14.02	14.95	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	155.56	157.18	153.11	144.45	133.52	123.24	116.38	114.76	118.83	127.49	138.42	148.7	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	31.92	(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=	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	-71.39	(71)
Water heating gains (Table 5)													
(72)m=	115.27	113.5	109.83	104.83	101.59	97.03	93.15	98.12	99.88	105.05	110.89	113.51	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	335.15	333.37	323.22	307.01	290.83	275.06	264.72	269.7	277.95	294.33	313.11	326.93	(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)	
Northeast 0.9x	0.77	x	4.95	x	11.28	x	0.5	x	0.7	=	13.55	(75)
Northeast 0.9x	0.77	x	4.95	x	22.97	x	0.5	x	0.7	=	27.57	(75)

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Northeast	0.9x	0.77	x	4.95	x	41.38	x	0.5	x	0.7	=	49.68	(75)
Northeast	0.9x	0.77	x	4.95	x	67.96	x	0.5	x	0.7	=	81.59	(75)
Northeast	0.9x	0.77	x	4.95	x	91.35	x	0.5	x	0.7	=	109.67	(75)
Northeast	0.9x	0.77	x	4.95	x	97.38	x	0.5	x	0.7	=	116.92	(75)
Northeast	0.9x	0.77	x	4.95	x	91.1	x	0.5	x	0.7	=	109.38	(75)
Northeast	0.9x	0.77	x	4.95	x	72.63	x	0.5	x	0.7	=	87.2	(75)
Northeast	0.9x	0.77	x	4.95	x	50.42	x	0.5	x	0.7	=	60.54	(75)
Northeast	0.9x	0.77	x	4.95	x	28.07	x	0.5	x	0.7	=	33.7	(75)
Northeast	0.9x	0.77	x	4.95	x	14.2	x	0.5	x	0.7	=	17.05	(75)
Northeast	0.9x	0.77	x	4.95	x	9.21	x	0.5	x	0.7	=	11.06	(75)
Northwest	0.9x	0.77	x	1.67	x	11.28	x	0.5	x	0.7	=	9.14	(81)
Northwest	0.9x	0.77	x	1.67	x	22.97	x	0.5	x	0.7	=	18.61	(81)
Northwest	0.9x	0.77	x	1.67	x	41.38	x	0.5	x	0.7	=	33.52	(81)
Northwest	0.9x	0.77	x	1.67	x	67.96	x	0.5	x	0.7	=	55.05	(81)
Northwest	0.9x	0.77	x	1.67	x	91.35	x	0.5	x	0.7	=	74	(81)
Northwest	0.9x	0.77	x	1.67	x	97.38	x	0.5	x	0.7	=	78.89	(81)
Northwest	0.9x	0.77	x	1.67	x	91.1	x	0.5	x	0.7	=	73.8	(81)
Northwest	0.9x	0.77	x	1.67	x	72.63	x	0.5	x	0.7	=	58.84	(81)
Northwest	0.9x	0.77	x	1.67	x	50.42	x	0.5	x	0.7	=	40.85	(81)
Northwest	0.9x	0.77	x	1.67	x	28.07	x	0.5	x	0.7	=	22.74	(81)
Northwest	0.9x	0.77	x	1.67	x	14.2	x	0.5	x	0.7	=	11.5	(81)
Northwest	0.9x	0.77	x	1.67	x	9.21	x	0.5	x	0.7	=	7.46	(81)

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

(83)m=	22.69	46.18	83.2	136.64	183.67	195.81	183.18	146.03	101.38	56.44	28.55	18.53	(83)

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

(84)m=	357.84	379.55	406.42	443.65	474.5	470.87	447.9	415.74	379.33	350.77	341.66	345.46	(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=	0.95	0.93	0.9	0.82	0.69	0.53	0.4	0.44	0.66	0.85	0.92	0.95	(86)

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

(87)m=	19.53	19.69	20	20.42	20.75	20.93	20.98	20.97	20.84	20.45	19.94	19.5	(87)

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

(88)m=	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.25	(88)

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

(89)m=	0.94	0.92	0.89	0.8	0.66	0.48	0.34	0.38	0.61	0.82	0.91	0.95	(89)

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

(90)m=	18.25	18.49	18.94	19.53	19.96	20.19	20.25	20.24	20.1	19.57	18.85	18.22	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	18.81	19.01	19.4	19.92	20.3	20.51	20.57	20.56	20.42	19.95	19.32	18.77	(92)

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

(93)m=	18.81	19.01	19.4	19.92	20.3	20.51	20.57	20.56	20.42	19.95	19.32	18.77	(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=	0.93	0.91	0.87	0.79	0.66	0.5	0.36	0.4	0.62	0.81	0.9	0.93	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	331.18	344.88	353.85	350.35	313.59	233.35	162.46	168.33	235.47	285.62	307.1	321.81	(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=	631.64	612.66	558.52	470.19	366.18	247.94	166.3	173.87	266.7	398.03	523.15	627.38	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	223.54	179.95	152.27	86.28	39.13	0	0	0	0	83.63	155.56	227.34	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1147.7	(98)
Space heating requirement in kWh/m²/year	21.57	(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		1147.7	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1205.09	(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		1855.86	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1558.93	(310a)

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Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	389.73	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	12.05	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	19.49	(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		103.54	(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) =	103.54	(331)
Energy for lighting (calculated in Appendix L)		256.89	(332)

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				290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	215.67	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	6.25	(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				290	(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	=	278.99	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	202.27	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	10.11	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)			=	713.3	(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) =				713.3	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	53.74	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	133.32	(379)
Total CO2, kg/year	sum of (376) (382) =				900.36	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.92	(384)
EI rating (section 14)					87.72	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 07-Green

Address : Flat 07, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	63.73	(1a) x	2.2	(2a) =	140.21	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.73	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	140.21	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 76.5 (23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			3.4	x1/[1/(1.2)+ 0.04]		=	3.89			(27)
Windows Type 2			1.8	x1/[1/(1.2)+ 0.04]		=	2.06			(27)
Windows Type 3			2.07	x1/[1/(1.2)+ 0.04]		=	2.37			(27)
Walls Type1	51.69	10.87	40.82	x	0.12	=	4.9			(29)
Walls Type2	9.19	1.98	7.21	x	0.12	=	0.83			(29)
Roof	63.73	0	63.73	x	0.12	=	7.65			(30)
Total area of elements, m²			124.61							(31)
Party wall			28.69	x	0	=	0			(32)
Party floor			63.73							(32a)
Party ceiling			14.48							(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) = 28.6 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8126.04 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 18.69 (36)

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

Total fabric heat loss (33) + (36) = 47.29 (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=	13.62	13.46	13.3	12.5	12.34	11.54	11.54	11.37	11.86	12.34	12.66	12.98	(38)

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

(39)m=	60.91	60.75	60.59	59.79	59.63	58.83	58.83	58.66	59.15	59.63	59.95	60.27	

Average = Sum(39)1…12 /12= 59.75 (39)

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

(40)m=	0.96	0.95	0.95	0.94	0.94	0.92	0.92	0.92	0.93	0.94	0.94	0.95	

Average = Sum(40)1…12 /12= 0.94 (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 2.08 (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 83.72 (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=	92.09	88.74	85.39	82.04	78.69	75.34	75.34	78.69	82.04	85.39	88.74	92.09	

Total = Sum(44)1…12 = 1004.6 (44)

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

(45)m=	136.56	119.44	123.25	107.45	103.1	88.97	82.44	94.61	95.74	111.57	121.79	132.25	

Total = Sum(45)1…12 = 1317.18 (45)

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

(46)m=	20.48	17.92	18.49	16.12	15.47	13.35	12.37	14.19	14.36	16.74	18.27	19.84	(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=	191.84	169.37	178.53	160.95	158.38	142.46	137.72	149.88	149.23	166.85	175.28	187.53	(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=	191.84	169.37	178.53	160.95	158.38	142.46	137.72	149.88	149.23	166.85	175.28	187.53

Output from water heater (annual)1…12 — 1968.02 (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=	89.63	79.66	85.2	78.52	78.5	72.38	71.63	75.68	74.63	81.32	83.29	88.2	(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=	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	104.24	(66)

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

(67)m=	16.75	14.87	12.1	9.16	6.85	5.78	6.24	8.12	10.9	13.83	16.15	17.21	(67)

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

(68)m=	182.25	184.14	179.37	169.23	156.42	144.38	136.34	134.45	139.22	149.36	162.17	174.21	(68)

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

(69)m=	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	33.42	(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=	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	-83.4	(71)

Water heating gains (Table 5)

(72)m=	120.47	118.54	114.52	109.06	105.52	100.52	96.28	101.72	103.65	109.3	115.68	118.54	(72)

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

(73)m=	373.74	371.82	360.26	341.72	323.05	304.96	293.14	298.56	308.03	326.77	348.27	364.23	(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	3.4	x	11.28	x	0.5	x	0.7	=	9.3	(75)
Northeast 0.9x	0.77	x	3.4	x	22.97	x	0.5	x	0.7	=	18.94	(75)
Northeast 0.9x	0.77	x	3.4	x	41.38	x	0.5	x	0.7	=	34.12	(75)
Northeast 0.9x	0.77	x	3.4	x	67.96	x	0.5	x	0.7	=	56.04	(75)
Northeast 0.9x	0.77	x	3.4	x	91.35	x	0.5	x	0.7	=	75.33	(75)
Northeast 0.9x	0.77	x	3.4	x	97.38	x	0.5	x	0.7	=	80.31	(75)
Northeast 0.9x	0.77	x	3.4	x	91.1	x	0.5	x	0.7	=	75.13	(75)
Northeast 0.9x	0.77	x	3.4	x	72.63	x	0.5	x	0.7	=	59.89	(75)
Northeast 0.9x	0.77	x	3.4	x	50.42	x	0.5	x	0.7	=	41.58	(75)
Northeast 0.9x	0.77	x	3.4	x	28.07	x	0.5	x	0.7	=	23.15	(75)
Northeast 0.9x	0.77	x	3.4	x	14.2	x	0.5	x	0.7	=	11.71	(75)
Northeast 0.9x	0.77	x	3.4	x	9.21	x	0.5	x	0.7	=	7.6	(75)
Northwest 0.9x	0.77	x	1.8	x	11.28	x	0.5	x	0.7	=	14.78	(81)
Northwest 0.9x	0.77	x	2.07	x	11.28	x	0.5	x	0.7	=	5.66	(81)
Northwest 0.9x	0.77	x	1.8	x	22.97	x	0.5	x	0.7	=	30.08	(81)
Northwest 0.9x	0.77	x	2.07	x	22.97	x	0.5	x	0.7	=	11.53	(81)
Northwest 0.9x	0.77	x	1.8	x	41.38	x	0.5	x	0.7	=	54.2	(81)
Northwest 0.9x	0.77	x	2.07	x	41.38	x	0.5	x	0.7	=	20.78	(81)
Northwest 0.9x	0.77	x	1.8	x	67.96	x	0.5	x	0.7	=	89.01	(81)
Northwest 0.9x	0.77	x	2.07	x	67.96	x	0.5	x	0.7	=	34.12	(81)
Northwest 0.9x	0.77	x	1.8	x	91.35	x	0.5	x	0.7	=	119.64	(81)
Northwest 0.9x	0.77	x	2.07	x	91.35	x	0.5	x	0.7	=	45.86	(81)
Northwest 0.9x	0.77	x	1.8	x	97.38	x	0.5	x	0.7	=	127.55	(81)
Northwest 0.9x	0.77	x	2.07	x	97.38	x	0.5	x	0.7	=	48.89	(81)
Northwest 0.9x	0.77	x	1.8	x	91.1	x	0.5	x	0.7	=	119.32	(81)
Northwest 0.9x	0.77	x	2.07	x	91.1	x	0.5	x	0.7	=	45.74	(81)
Northwest 0.9x	0.77	x	1.8	x	72.63	x	0.5	x	0.7	=	95.12	(81)
Northwest 0.9x	0.77	x	2.07	x	72.63	x	0.5	x	0.7	=	36.46	(81)
Northwest 0.9x	0.77	x	1.8	x	50.42	x	0.5	x	0.7	=	66.04	(81)
Northwest 0.9x	0.77	x	2.07	x	50.42	x	0.5	x	0.7	=	25.32	(81)
Northwest 0.9x	0.77	x	1.8	x	28.07	x	0.5	x	0.7	=	36.76	(81)
Northwest 0.9x	0.77	x	2.07	x	28.07	x	0.5	x	0.7	=	14.09	(81)
Northwest 0.9x	0.77	x	1.8	x	14.2	x	0.5	x	0.7	=	18.59	(81)
Northwest 0.9x	0.77	x	2.07	x	14.2	x	0.5	x	0.7	=	7.13	(81)
Northwest 0.9x	0.77	x	1.8	x	9.21	x	0.5	x	0.7	=	12.07	(81)
Northwest 0.9x	0.77	x	2.07	x	9.21	x	0.5	x	0.7	=	4.63	(81)

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

(83)m=	29.75	60.55	109.1	179.17	240.84	256.76	240.19	191.48	132.94	74	37.43	24.29	(83)

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

(84)m=	403.48	432.37	469.36	520.88	563.89	561.72	533.33	490.04	440.97	400.77	385.7	388.53	(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=	0.96	0.95	0.92	0.86	0.74	0.59	0.46	0.51	0.72	0.88	0.94	0.96	(86)

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

(87)m=	19.11	19.29	19.65	20.16	20.59	20.86	20.95	20.93	20.72	20.19	19.58	19.07	(87)

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

(88)m=	20.12	20.12	20.12	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13	(88)

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

(89)m=	0.95	0.94	0.91	0.83	0.7	0.53	0.38	0.43	0.67	0.86	0.93	0.96	(89)

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

(90)m=	17.57	17.84	18.36	19.08	19.67	20.01	20.11	20.1	19.86	19.15	18.27	17.53	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.29	18.52	18.97	19.59	20.1	20.41	20.51	20.49	20.27	19.64	18.88	18.26	(92)

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

(93)m=	18.29	18.52	18.97	19.59	20.1	20.41	20.51	20.49	20.27	19.64	18.88	18.26	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.94	0.92	0.89	0.82	0.7	0.55	0.41	0.46	0.67	0.85	0.92	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	378.55	399.24	417.79	426.62	396.28	306.97	219.04	224.85	297.55	339.36	353.76	366.56	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	852.27	827.43	755.57	639.08	500.88	341.78	229.82	239.98	364.73	538.92	706.46	847.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	352.45	287.75	251.3	152.97	77.82	0	0	0	0	148.47	253.94	357.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1882.24 (98)

Space heating requirement in kWh/m²/year 29.53 (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		1882.24	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1976.35	(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		1968.02	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1653.14	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	413.28	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	19.76	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	20.66	(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		124.01	(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) =	124.01	(331)
Energy for lighting (calculated in Appendix L)		295.76	(332)

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				290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	353.7	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.26	(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				290	(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	=	295.85	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	214.49	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	10.72	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)			=	885.03	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)

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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) =			885.03	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	64.36	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	153.5	(379)
Total CO2, kg/year	sum of (376) (382) =			1102.89	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.31	(384)
EI rating (section 14)				86.41	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: Flat 08-Green

Address : Flat 08, 51 Calthorpe Street, LONDON, WC1X 0HH

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	7.67	(1a)	x	2.5	(2a)	=	19.18	(3a)
First floor	138.42	(1b)	x	2.5	(2b)	=	346.05	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	146.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	365.22	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.15	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.18

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) = 73.1 (23c)

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

(24a)m=	0.33	0.32	0.32	0.3	0.3	0.28	0.28	0.27	0.28	0.3	0.3	0.31	(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=	0.33	0.32	0.32	0.3	0.3	0.28	0.28	0.27	0.28	0.3	0.3	0.31	(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			1.98	x	1.4	=	2.772			(26)
Windows Type 1			1.45	x1/[1/(1.2)+ 0.04]		=	1.66			(27)
Windows Type 2			3.21	x1/[1/(1.2)+ 0.04]		=	3.68			(27)
Windows Type 3			1.56	x1/[1/(1.2)+ 0.04]		=	1.79			(27)
Rooflights Type 1			1.38	x1/[1/(1.2) + 0.04]		=	1.656			(27b)
Rooflights Type 2			1.32	x1/[1/(1.2) + 0.04]		=	1.584			(27b)
Floor			16.84	x	0.12	=	2.0208			(28)
Walls Type1	58.24	3.12	55.12	x	0.12	=	6.61			(29)
Walls Type2	30.56	1.98	28.58	x	0.12	=	3.31			(29)
Walls Type3	63.68	0	63.68	x	0.12	=	7.64			(29)
Walls Type4	21.95	16.57	5.38	x	0.2	=	1.08			(29)
Roof Type1	110.25	2.7	107.55	x	0.12	=	12.91			(30)
Roof Type2	6.05	0	6.05	x	0.15	=	0.91			(30)
Total area of elements, m²			307.57							(31)
Party wall			19.63	x	0	=	0			(32)
Party floor			121.58							(32a)
Party ceiling			14.48							(32b)

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** 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) =	62.88	(33)
Heat capacity Cm = S(A x k)	((28) (30) + (32) + (32a) (32e) =	15227.24	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Low	100	(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		46.14	(36)

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

Total fabric heat loss	(33) + (36) =	109.02	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	39.26	38.81	38.36	36.1	35.65	33.39	33.39	32.93	34.29	35.65	36.55	37.45	(38)

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

(39)m=	148.28	147.83	147.37	145.11	144.66	142.4	142.4	141.95	143.31	144.66	145.57	146.47

Average = Sum(39)$_{1…12}$ /12= 145 (39)

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

(40)m=	1.01	1.01	1.01	0.99	0.99	0.97	0.97	0.97	0.98	0.99	1	1

Average = Sum(40)$_{1…12}$ /12= 0.99 (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	2.93	(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	103.74	(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=	114.11	109.96	105.81	101.66	97.51	93.36	93.36	97.51	101.66	105.81	109.96	114.11

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

Total = Sum(44)$_{1…12}$ = 1244.85 (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=	169.22	148	152.73	133.15	127.76	110.25	102.16	117.23	118.63	138.25	150.92	163.88

Total = Sum(45)$_{1…12}$ = 1632.19 (45)

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

(46)m=	25.38	22.2	22.91	19.97	19.16	16.54	15.32	17.58	17.79	20.74	22.64	24.58	(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)

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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=	224.5	197.93	208	186.64	183.04	163.74	157.44	172.51	172.13	193.53	204.41	219.16	(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=	224.5	197.93	208	186.64	183.04	163.74	157.44	172.51	172.13	193.53	204.41	219.16	

Output from water heater (annual)$_{1 \ldots 12}$ | 2283.03 | (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=	100.49	89.15	95	87.07	86.7	79.45	78.19	83.2	82.24	90.19	92.97	98.71	(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=	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	146.39	(66)

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

(67)m=	29.4	26.12	21.24	16.08	12.02	10.15	10.96	14.25	19.13	24.29	28.35	30.22	(67)

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

(68)m=	316.24	319.52	311.25	293.64	271.42	250.54	236.58	233.3	241.57	259.17	281.4	302.28	(68)

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

(69)m=	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	37.64	(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=	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	-117.12	(71)

Water heating gains (Table 5)

(72)m=	135.06	132.67	127.69	120.93	116.54	110.35	105.09	111.83	114.22	121.22	129.13	132.68	(72)

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

(73)m=	547.62	545.22	527.1	497.57	466.89	437.95	419.56	426.3	441.84	471.61	505.8	532.1	(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)	
Northeast 0.9x	0.77	x	1.56	x	11.28	x	0.5	x	0.7	=	8.54	(75)
Northeast 0.9x	0.77	x	1.56	x	22.97	x	0.5	x	0.7	=	17.38	(75)
Northeast 0.9x	0.77	x	1.56	x	41.38	x	0.5	x	0.7	=	31.31	(75)
Northeast 0.9x	0.77	x	1.56	x	67.96	x	0.5	x	0.7	=	51.43	(75)
Northeast 0.9x	0.77	x	1.56	x	91.35	x	0.5	x	0.7	=	69.13	(75)
Northeast 0.9x	0.77	x	1.56	x	97.38	x	0.5	x	0.7	=	73.7	(75)
Northeast 0.9x	0.77	x	1.56	x	91.1	x	0.5	x	0.7	=	68.94	(75)
Northeast 0.9x	0.77	x	1.56	x	72.63	x	0.5	x	0.7	=	54.96	(75)
Northeast 0.9x	0.77	x	1.56	x	50.42	x	0.5	x	0.7	=	38.16	(75)
Northeast 0.9x	0.77	x	1.56	x	28.07	x	0.5	x	0.7	=	21.24	(75)
Northeast 0.9x	0.77	x	1.56	x	14.2	x	0.5	x	0.7	=	10.74	(75)
Northeast 0.9x	0.77	x	1.56	x	9.21	x	0.5	x	0.7	=	6.97	(75)
Southeast 0.9x	0.77	x	1.45	x	36.79	x	0.5	x	0.7	=	90.58	(77)
Southeast 0.9x	0.77	x	1.45	x	62.67	x	0.5	x	0.7	=	154.29	(77)
Southeast 0.9x	0.77	x	1.45	x	85.75	x	0.5	x	0.7	=	211.11	(77)
Southeast 0.9x	0.77	x	1.45	x	106.25	x	0.5	x	0.7	=	261.58	(77)
Southeast 0.9x	0.77	x	1.45	x	119.01	x	0.5	x	0.7	=	292.99	(77)
Southeast 0.9x	0.77	x	1.45	x	118.15	x	0.5	x	0.7	=	290.87	(77)
Southeast 0.9x	0.77	x	1.45	x	113.91	x	0.5	x	0.7	=	280.43	(77)
Southeast 0.9x	0.77	x	1.45	x	104.39	x	0.5	x	0.7	=	257	(77)
Southeast 0.9x	0.77	x	1.45	x	92.85	x	0.5	x	0.7	=	228.59	(77)
Southeast 0.9x	0.77	x	1.45	x	69.27	x	0.5	x	0.7	=	170.53	(77)
Southeast 0.9x	0.77	x	1.45	x	44.07	x	0.5	x	0.7	=	108.5	(77)
Southeast 0.9x	0.77	x	1.45	x	31.49	x	0.5	x	0.7	=	77.52	(77)
Northwest 0.9x	0.77	x	3.21	x	11.28	x	0.5	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	3.21	x	22.97	x	0.5	x	0.7	=	35.76	(81)
Northwest 0.9x	0.77	x	3.21	x	41.38	x	0.5	x	0.7	=	64.43	(81)
Northwest 0.9x	0.77	x	3.21	x	67.96	x	0.5	x	0.7	=	105.82	(81)
Northwest 0.9x	0.77	x	3.21	x	91.35	x	0.5	x	0.7	=	142.24	(81)
Northwest 0.9x	0.77	x	3.21	x	97.38	x	0.5	x	0.7	=	151.64	(81)
Northwest 0.9x	0.77	x	3.21	x	91.1	x	0.5	x	0.7	=	141.86	(81)
Northwest 0.9x	0.77	x	3.21	x	72.63	x	0.5	x	0.7	=	113.09	(81)

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Northwest 0.9x	0.77	x	3.21	x	50.42	x	0.5	x	0.7	=	78.51	(81)
Northwest 0.9x	0.77	x	3.21	x	28.07	x	0.5	x	0.7	=	43.71	(81)
Northwest 0.9x	0.77	x	3.21	x	14.2	x	0.5	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	3.21	x	9.21	x	0.5	x	0.7	=	14.35	(81)
Rooflights 0.9x	1	x	1.38	x	26	x	0.5	x	0.8	=	12.92	(82)
Rooflights 0.9x	1	x	1.32	x	26	x	0.5	x	0.8	=	12.36	(82)
Rooflights 0.9x	1	x	1.38	x	54	x	0.5	x	0.8	=	26.83	(82)
Rooflights 0.9x	1	x	1.32	x	54	x	0.5	x	0.8	=	25.66	(82)
Rooflights 0.9x	1	x	1.38	x	96	x	0.5	x	0.8	=	47.69	(82)
Rooflights 0.9x	1	x	1.32	x	96	x	0.5	x	0.8	=	45.62	(82)
Rooflights 0.9x	1	x	1.38	x	150	x	0.5	x	0.8	=	74.52	(82)
Rooflights 0.9x	1	x	1.32	x	150	x	0.5	x	0.8	=	71.28	(82)
Rooflights 0.9x	1	x	1.38	x	192	x	0.5	x	0.8	=	95.39	(82)
Rooflights 0.9x	1	x	1.32	x	192	x	0.5	x	0.8	=	91.24	(82)
Rooflights 0.9x	1	x	1.38	x	200	x	0.5	x	0.8	=	99.36	(82)
Rooflights 0.9x	1	x	1.32	x	200	x	0.5	x	0.8	=	95.04	(82)
Rooflights 0.9x	1	x	1.38	x	189	x	0.5	x	0.8	=	93.9	(82)
Rooflights 0.9x	1	x	1.32	x	189	x	0.5	x	0.8	=	89.81	(82)
Rooflights 0.9x	1	x	1.38	x	157	x	0.5	x	0.8	=	78	(82)
Rooflights 0.9x	1	x	1.32	x	157	x	0.5	x	0.8	=	74.61	(82)
Rooflights 0.9x	1	x	1.38	x	115	x	0.5	x	0.8	=	57.13	(82)
Rooflights 0.9x	1	x	1.32	x	115	x	0.5	x	0.8	=	54.65	(82)
Rooflights 0.9x	1	x	1.38	x	66	x	0.5	x	0.8	=	32.79	(82)
Rooflights 0.9x	1	x	1.32	x	66	x	0.5	x	0.8	=	31.36	(82)
Rooflights 0.9x	1	x	1.38	x	33	x	0.5	x	0.8	=	16.39	(82)
Rooflights 0.9x	1	x	1.32	x	33	x	0.5	x	0.8	=	15.68	(82)
Rooflights 0.9x	1	x	1.38	x	21	x	0.5	x	0.8	=	10.43	(82)
Rooflights 0.9x	1	x	1.32	x	21	x	0.5	x	0.8	=	9.98	(82)

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

(83)m=	141.96	259.93	400.17	564.62	690.98	710.61	674.94	577.65	457.04	299.63	173.42	119.25	(83)

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

(84)m=	689.59	805.15	927.27	1062.19	1157.88	1148.56	1094.5	1003.96	898.88	771.23	679.22	651.35	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.89	0.79	0.65	0.52	0.57	0.78	0.92	0.97	0.98	(86)

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

(87)m=	18.69	18.94	19.38	19.95	20.45	20.79	20.92	20.9	20.62	19.97	19.24	18.65	(87)

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

(88)m=	20.07	20.07	20.08	20.09	20.09	20.1	20.1	20.11	20.1	20.09	20.09	20.08	(88)

DER WorkSheet: New dwelling design stage

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

(89)m=	0.98	0.96	0.94	0.87	0.76	0.59	0.43	0.48	0.73	0.91	0.96	0.98	(89)

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

(90)m=	16.94	17.31	17.94	18.77	19.46	19.9	20.05	20.03	19.71	18.81	17.75	16.9	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	17.6	17.93	18.48	19.21	19.83	20.24	20.38	20.35	20.05	19.25	18.31	17.56	(92)

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

(93)m=	17.6	17.93	18.48	19.21	19.83	20.24	20.38	20.35	20.05	19.25	18.31	17.56	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.92	0.85	0.75	0.6	0.46	0.51	0.72	0.89	0.95	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	666.11	763.98	849.86	904.95	865.35	689	500.71	510.35	649.81	684.07	645.71	632.1	(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=	1972.22	1925.85	1766	1496.84	1176.05	802.57	537.91	561.28	852.75	1251.31	1631.79	1956.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	971.74	780.78	681.61	426.16	231.16	0	0	0	0	422.03	709.98	985.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5208.81 (98)

Space heating requirement in kWh/m²/year 35.65 (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	5208.81

DER WorkSheet: New dwelling design stage

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	5469.25	(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		2283.03	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1917.75	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	479.44	(310b)
Electricity used for heat distribution	0.01 × [(307a) (307e) + (310a) (310e)] =	54.69	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a) (307e) + (310a) (310e)] =	23.97	(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		395.45	(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) =	395.45	(331)
Energy for lighting (calculated in Appendix L)		519.29	(332)

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				290	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	978.81	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	28.39	(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				290	(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	=	343.21	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	248.83	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	12.44	(372)
Total CO2 associated with community systems	(363) (366) + (368)...(372)			=	1611.67	(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) =				1611.67	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	205.24	(378)

CO2 associated with electricity for lighting	(332))) x	0.52	=	269.51	(379)
Total CO2, kg/year	sum of (376) (382) =			2086.42	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.28	(384)
EI rating (section 14)				85.37	(385)

Appendix B
Energy Assessment
51 Calthorpe Street

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Baseline Non–domestic – TER from the Be Lean scenario BRUKL
Be Lean Non–domestic – BER from the Be Lean scenario BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

51 Calthorpe Street

As designed

Date: Fri Aug 21 11:36:24 2020

Administrative information

Building Details

Address: 51 Calthorpe Street, , WC1X 0HH

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.2

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	28
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	28
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	25.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.23	1-Lower Ground Floor - Meeting Room 1_W_7
Floor	0.25	0.08	0.12	1-Lower Ground Floor - Meeting Room 1_F_3
Roof	0.25	0.12	0.12	1-Lower Ground Floor - Circulation_R_5
Windows***, roof windows, and rooflights	2.2	1.45	1.6	1-Lower Ground Floor - Meeting Room 1_G_8
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- Project HVAC

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	3.8	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Project DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0-Basement - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - Meeting Room 3	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - WC	0.3	-	-	-	-	-	-	-	-	-	N/A
0-Basement - Meeting Room 1	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - Meeting Room 2	-	-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-1		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-3		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-2		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - WC	0.3	-	-	-	-	-	-	-	-	-	N/A
2-Ground Floor - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
2-Ground Floor - WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Basement - Office	120	-	-	1545

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Basement - Staircase	-	120	-	24
0-Basement - Meeting Room 3	120	-	-	302
0-Basement - WC	-	120	-	44
0-Basement - Meeting Room 1	120	-	-	140
0-Basement - Meeting Room 2	120	-	-	216
1-Lower Ground Floor - Meeting Room 1	120	-	-	213
1-Lower Ground Floor - Office	120	-	-	1385
1-Lower Ground Floor - Staircase	-	120	-	39
1-Lower Ground Floor - Circulation	-	120	-	62
1-Lower Ground Floor - Meeting Room 3	120	-	-	117
1-Lower Ground Floor - Meeting Room 2	120	-	-	166
1-Lower Ground Floor - WC	-	120	-	26
1-Lower Ground Floor - Storage	120	-	-	16
2-Ground Floor - Storage	120	-	-	15
2-Ground Floor - Office	120	-	-	1154
2-Ground Floor - Staircase 2	-	120	-	17
2-Ground Floor - Staircase 1	-	120	-	21
2-Ground Floor - WC	-	120	-	27
2-Ground Floor - Lift	-	120	-	11
2-Ground Floor - Circulation	-	120	-	37

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0-Basement - Office	NO (-68.8%)	NO
0-Basement - Staircase	N/A	N/A
0-Basement - Meeting Room 3	N/A	N/A
0-Basement - WC	N/A	N/A
0-Basement - Meeting Room 1	N/A	N/A
0-Basement - Meeting Room 2	NO (-62.1%)	NO
1-Lower Ground Floor - Meeting Room 1	NO (-62%)	NO
1-Lower Ground Floor - Office	NO (-58.9%)	NO
1-Lower Ground Floor - Staircase	N/A	N/A
1-Lower Ground Floor - Circulation	N/A	N/A
1-Lower Ground Floor - Meeting Room 3	N/A	N/A
1-Lower Ground Floor - Meeting Room 2	N/A	N/A
1-Lower Ground Floor - WC	N/A	N/A
1-Lower Ground Floor - Storage	N/A	N/A
2-Ground Floor - Storage	N/A	N/A
2-Ground Floor - Office	NO (-59.3%)	NO
2-Ground Floor - Staircase 2	N/A	N/A
2-Ground Floor - Staircase 1	N/A	N/A
2-Ground Floor - WC	N/A	N/A
2-Ground Floor - Lift	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-Ground Floor - Circulation	YES (+61.5%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1233.7	1233.7
External area [m^2]	1305.6	1305.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	329.74	541.31
Average U-value [W/m^2K]	0.25	0.41
Alpha value* [%]	21.43	14.51

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	3.9	6.75
Cooling	10.4	7.57
Auxiliary	3.86	2.58
Lighting	12.12	21.08
Hot water	49.55	49.55
Equipment*	36.38	36.38
TOTAL**	**79.82**	**87.53**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	123.52	117.96
Primary energy* [kWh/m^2]	146.16	162.16
Total emissions [kg/m^2]	25.2	28

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	11.9	111.6	3.9	10.4	3.9	0.85	2.98	0.91	4.2
	Notional	19.9	98.1	6.8	7.6	2.6	0.82	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.12	0-Basement - Office_W_7
Floor	0.2	0.08	0-Basement - Office_S_3
Roof	0.15	0.12	1-Lower Ground Floor - Circulation_R_5
Windows, roof windows, and rooflights	1.5	1.2	0-Basement - Office_G_9
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

Appendix B
Energy Assessment
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Be Green Non-domestic – BER from the Be Green scenario BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

51 Calthorpe Street

As designed

Date: Fri Aug 21 12:05:04 2020

Administrative information

Building Details

Address: 51 Calthorpe Street, , WC1X 0HH

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.2

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	26.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	26.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	24.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.23	1-Lower Ground Floor - Meeting Room 1_W_7
Floor	0.25	0.08	0.12	1-Lower Ground Floor - Meeting Room 1_F_3
Roof	0.25	0.12	0.12	1-Lower Ground Floor - Circulation_R_5
Windows***, roof windows, and rooflights	2.2	1.45	1.6	1-Lower Ground Floor - Meeting Room 1_G_8
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

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

1- Project HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.9	3.8	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.1	-
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0-Basement - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - Meeting Room 3	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - WC	0.3	-	-	-	-	-	-	-	-	-	N/A
0-Basement - Meeting Room 1	-	-	-	1.4	-	-	-	-	-	0.85	0.5
0-Basement - Meeting Room 2	-	-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-1		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-3		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - Meeting Room-2		-	-	1.4	-	-	-	-	-	0.85	0.5
1-Lower Ground Floor - WC	0.3	-	-	-	-	-	-	-	-	-	N/A
2-Ground Floor - Office	-	-	-	1.4	-	-	-	-	-	0.85	0.5
2-Ground Floor - WC	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Basement - Office	120	-	-	1545
0-Basement - Staircase	-	120	-	24
0-Basement - Meeting Room 3	120	-	-	302
0-Basement - WC	-	120	-	44
0-Basement - Meeting Room 1	120	-	-	140
0-Basement - Meeting Room 2	120	-	-	216
1-Lower Ground Floor - Meeting Room 1	120	-	-	213
1-Lower Ground Floor - Office	120	-	-	1385
1-Lower Ground Floor - Staircase	-	120	-	39
1-Lower Ground Floor - Circulation	-	120	-	62
1-Lower Ground Floor - Meeting Room 3	120	-	-	117
1-Lower Ground Floor - Meeting Room 2	120	-	-	166
1-Lower Ground Floor - WC	-	120	-	26
1-Lower Ground Floor - Storage	120	-	-	16
2-Ground Floor - Storage	120	-	-	15
2-Ground Floor - Office	120	-	-	1154
2-Ground Floor - Staircase 2	-	120	-	17
2-Ground Floor - Staircase 1	-	120	-	21
2-Ground Floor - WC	-	120	-	27
2-Ground Floor - Lift	-	120	-	11
2-Ground Floor - Circulation	-	120	-	37

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0-Basement - Office	NO (-68.8%)	NO
0-Basement - Staircase	N/A	N/A
0-Basement - Meeting Room 3	N/A	N/A
0-Basement - WC	N/A	N/A
0-Basement - Meeting Room 1	N/A	N/A
0-Basement - Meeting Room 2	NO (-62.1%)	NO
1-Lower Ground Floor - Meeting Room 1	NO (-62%)	NO
1-Lower Ground Floor - Office	NO (-58.9%)	NO
1-Lower Ground Floor - Staircase	N/A	N/A
1-Lower Ground Floor - Circulation	N/A	N/A
1-Lower Ground Floor - Meeting Room 3	N/A	N/A
1-Lower Ground Floor - Meeting Room 2	N/A	N/A
1-Lower Ground Floor - WC	N/A	N/A
1-Lower Ground Floor - Storage	N/A	N/A
2-Ground Floor - Storage	N/A	N/A
2-Ground Floor - Office	NO (-59.3%)	NO
2-Ground Floor - Staircase 2	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-Ground Floor - Staircase 1	N/A	N/A
2-Ground Floor - WC	N/A	N/A
2-Ground Floor - Lift	N/A	N/A
2-Ground Floor - Circulation	YES (+61.5%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1233.7	1233.7
External area [m^2]	1305.6	1305.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	329.74	541.31
Average U-value [W/m^2K]	0.25	0.41
Alpha value* [%]	21.43	14.51

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

Building Use

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

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	1.22	2.28
Cooling	10.4	7.57
Auxiliary	3.86	2.58
Lighting	12.12	21.08
Hot water	20.38	23.27
Equipment*	36.38	36.38
TOTAL**	**47.98**	**56.77**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	123.52	117.96
Primary energy* [kWh/m^2]	147.29	151.17
Total emissions [kg/m^2]	24.9	26.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	11.9	111.6	1.2	10.4	3.9	2.7	2.98	2.9	4.2
	Notional	19.9	98.1	2.3	7.6	2.6	2.43	3.6	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.12	0-Basement - Office_W_7
Floor	0.2	0.08	0-Basement - Office_S_3
Roof	0.15	0.12	1-Lower Ground Floor - Circulation_R_5
Windows, roof windows, and rooflights	1.5	1.2	0-Basement - Office_G_9
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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