
TP Bureau

Environmental Standards Statement

Proposed conversion development @ 17 Piccadilly, Manchester

19 May 2021

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1. Executive Summary

This Environmental Standards Statement has been prepared by Watt Energy on behalf of TP Bureau to support a planning application for the development 17 Piccadilly. The statement specifically addresses the following Manchester Council approved climate change action plans in addition to planning policies, as stipulated in the Manchester Core Strategy (July 2012):

- Our Manchester Strategy 2016-2025
- Manchester: A Certain Future
- Manchester Climate Change Board – The Zero Carbon Framework
- Climate Change and Low Emissions Implementation Plan 2016-2020
- Unitary Development Plan
- Policy DM 1 - Development Management
- Policy EN 4 - Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development
- Policy EN 6 - Target Framework for CO₂ Reductions from Low or Zero Carbon Energy Supplies

The statement details how the development will incorporate sustainable design and resource efficiency in line with the both the Energy Hierarchy and national sustainable design definitions, so to meet the policy requirements and council targets whilst reducing its overall environmental impact. The methodology and calculations are consistent with the MCC Appendix A EN6 Energy Target Explanation and all figures used within this report have been based on the most recent issue of drawings and modelled using SAP 2012 to accurately predict Energy Usage and CO₂ reductions.

In relation to the planning documents and policies outlined above, the development is required to achieve a **10%** reduction in carbon emissions over Part L 2013 of the Building Regulations.

In order to achieve compliance, the development will utilise highly efficient electric panel heaters and immersion cylinders to satisfy the heating and hot water requirements, whilst also being designed with a fabric first approach to ensure all improvement possible are undertaken.

Following the LZC feasibility assessment, it is not proposed that any additional technologies will be proposed at this stage. This is a result of the development being a listed building and also sufficient savings in carbon emissions being experienced through efficient design measures alone.

As a result of the above the predicted site wide reduction in CO₂ over Part L 2013 of the Building Regulations is **18.0%**.

The development therefore complies with Manchester City Council's current and future policy requirements and planning targets.

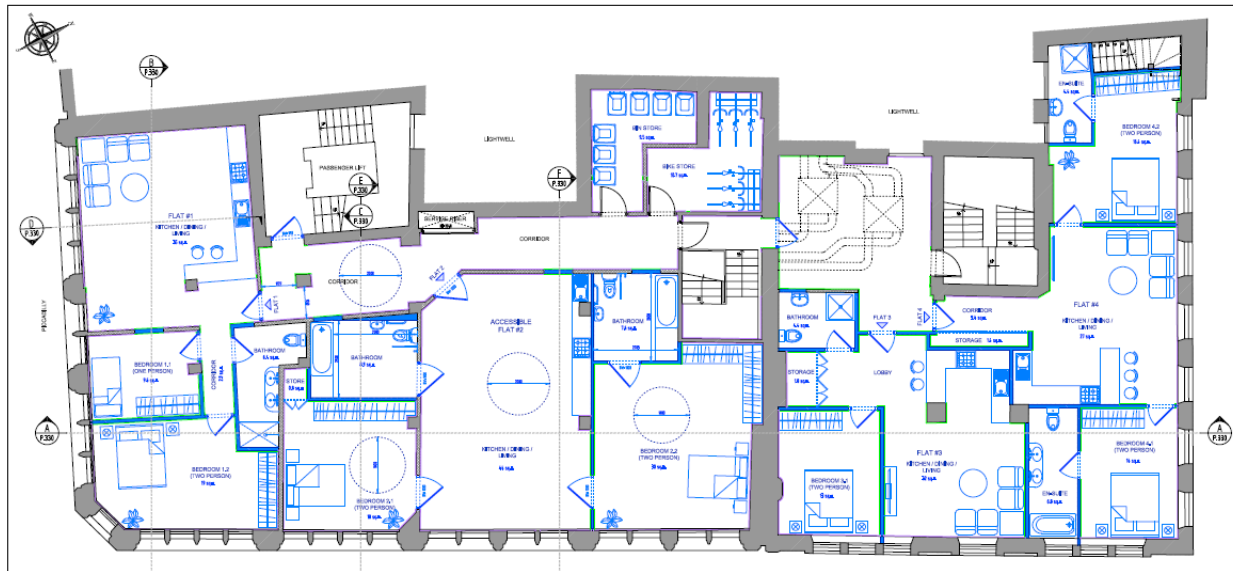


2. Planning Statement

The following statement relates to the proposed development at 17 Piccadilly, Manchester.

2.1 The Development

The development at the 17 Piccadilly includes the conversion of the existing building to create 4no new flats, including one accessible flat, and internal cycle and bin stores.



Proposed 1st F Plans (Not to scale)

2.2 Relevant Policies, Targets and Definitions

2.2.1 Manchester City Council Policies and Targets

This statement is prepared in the context of the following policies in the Manchester Core Strategy (July 2012):

- Policy EN 4 Reducing CO2 Emissions by Enabling Low and Zero Carbon Development.
- Policy EN 6 Target Framework for CO2 reductions from low or zero carbon energy supplies.

This statement also addresses the Carbon Reduction Targets from other Manchester Climate Change action plans including:

- Our Manchester 2016-25, Manchester: A Certain Future
- Manchester Climate Change Board – Zero Carbon Framework
- Climate Change and Low Emissions Implementation Plan 2016-20:

Since 2012 The Core Strategy Planning Policies EN 4 and EN 6 have established well defined carbon reduction targets and design strategies for achieving them.

However, the more recent planning Climate Change Action Plans and other National Planning Strategies have used various definitions and Sustainable Design Targets that are still open to interpretation.

The following section details the various Sustainable Design definitions and how they relate to the above documents.



2.2.2 Manchester City Council's Planning Document Targets

Manchester City Planning Policy currently uses the following documents to look to establish the carbon reduction targets to be achieved in new developments across the City.

These documents use different terminology to describe achieving the various reduced carbon emissions.

Please see below a summary of the terminology and targets set out within the current Manchester Planning Policy documents:

Planning Document:	Time of Production or Adoption:	Equivalent Carbon Target:
Manchester Council's Core Strategy 2012-2027	Adopted 2012	Targets a 9% reduction in carbon emissions over Part L Building Regulations.
Climate Change and Low Emission Strategies 2016-2020	Adopted 2016	Targets a 48% reduction in carbon emissions from 1990 - 2020
Manchester: A Certain Future	Produced in 2009, updated in 2013	Targets emitting 41% less CO ₂ in 2020 than in 2005 – Equates to 10% over Part L 2013 (if going by Part L requirements)



2.3 Sustainable Design Strategy

2.3.1 Energy and Carbon Emissions

Energy Hierarchy

In response to the policy requirements and climate change plan targets set out in section 2.2, developments should aim to assist and achieve the following carbon reduction targets:

1. Achieve a minimum of 10% CO₂ reduction over the Part L 2013 Target Emission Rate (TER), as per Target 2 (Electricity intense buildings) in Table 12.1 of Policy EN6.

To achieve the most accurate calculations and estimates, the serviced apartments have been modelled using *SAP 2012* the governments Standard Assessment Procedure.

A Part L compliant baseline has been established and then further improvements have been made to the building fabric and specification prior to the addition of LZC technologies. This complies with the Energy Hierarchy:



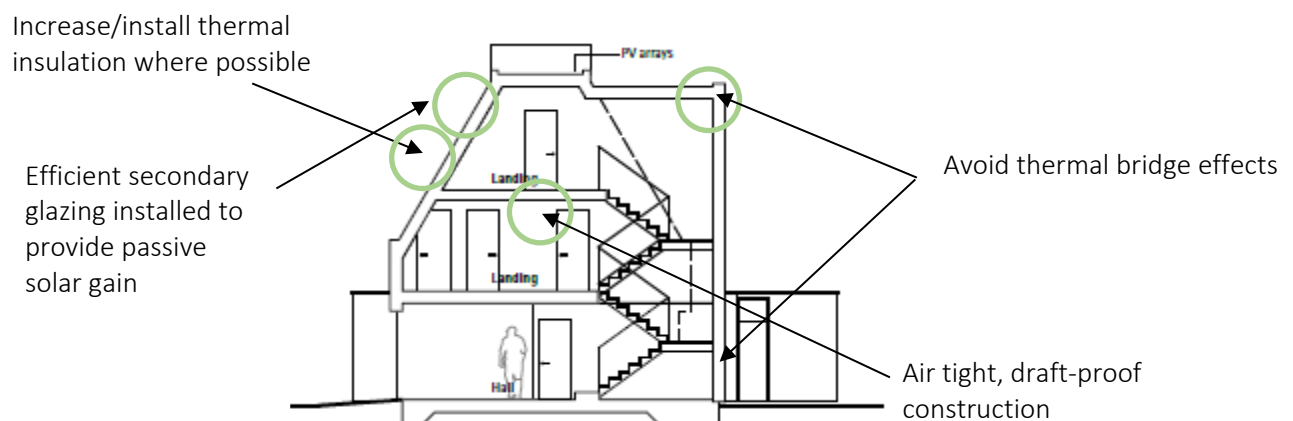
In accordance with the above methodology, the development is targeting a low carbon classification and will be designed with a fabric first approach. Resulting in a development that demonstrates a low energy design concept, has significant carbon reductions and far exceeds Building Regulations compliancy.

In addition to the targeting of a low carbon classification, as a result of the design principles mentioned above and specific measures outlined in the next section, the development can also be defined a carbon neutral. This is because the proposal will have net zero carbon emissions, directly due to obtaining all the energy used on site from a 100% renewable energy electricity supply provider.

Efficient and Sustainable Design Measures

In line with the above Sustainable Design Strategy, the following Energy Efficient design measures are specified.

- Sealing all edges and junctions throughout to minimise thermal bridges
- Passive solar gains and internal heat sources
- Good indoor air quality by openable windows



The Proposed specifications and key energy efficient design measures are as follows:

- Existing glazing, to be retained, secondary glazed to achieve U-values of $2.4 \text{ W/m}^2\text{K}$
- 100% low energy lighting throughout
- 100% efficient electric panel heaters provided to each flat
- Efficient 120/150L hot water cylinders to each flat

2.3.2 Choice and Impact of Renewable Technology

All reasonable technologies were investigated for their suitability to the site and development; please refer to section 3 for details.

In addition to energy efficiency measures, it is proposed that the development will not feature any additional technologies that those provided as part of the efficient design stage. This is due to sufficient carbon emissions savings being achieved solely through the application of efficient design measures.



2.3.3 Energy and CO₂ Reduction Summary

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction are shown in Figures 1 & 2 below:

Summary of CO ₂ Emission Reductions	Total CO ₂ emissions (kgCO ₂ /year)
Baseline emissions	18447.6
Improved emissions (after application of energy efficiency measures)	15126.0
Improved emissions (after incorporation of efficient energy supply)	15126.0
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	15126.0
% CO ₂ displaced in total	18.0%
% CO ₂ displaced by energy efficiency measures	18.0%
% CO ₂ displaced by efficient supply of energy	0.0%
% CO ₂ displaced by renewable energy	0.0%

Fig 1. Summary of CO₂ Reductions



	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO ₂ emissions (kg pa)	Saving achieved on residual CO ₂ emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	35544.6		18447.6	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	29144.6	18.0%	15126.0	18.0%
Proposed scheme after on-site renewables	29144.6	18.0%	15126.0	0.0%
Proposed scheme offset for financial contribution or other "allowable solution"	0	0	0	0
Total savings on carbon emissions and energy demand		18.0%		18.0%

Fig 2. Total energy and carbon emission savings



For a full Breakdown of the figures and calculations please see Appendix A – Energy Demand Assessment Spreadsheet.

Baseline energy demand

‘Standard Assessment Procedure - SAP 2012’ was used to produce example SAP reports to generate the figures used within the calculations.

Baseline energy demand (kWh pa)	35544.6
Regulated emissions (kg pa)	18447.6

Heating

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures and as can be seen in Figure 1.

Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	18447.6

Energy efficiency

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

Energy savings from energy efficiency measures (kWh pa)	6400.0
Emission savings from energy efficiency measures (kg pa)	3321.6
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	15126.0

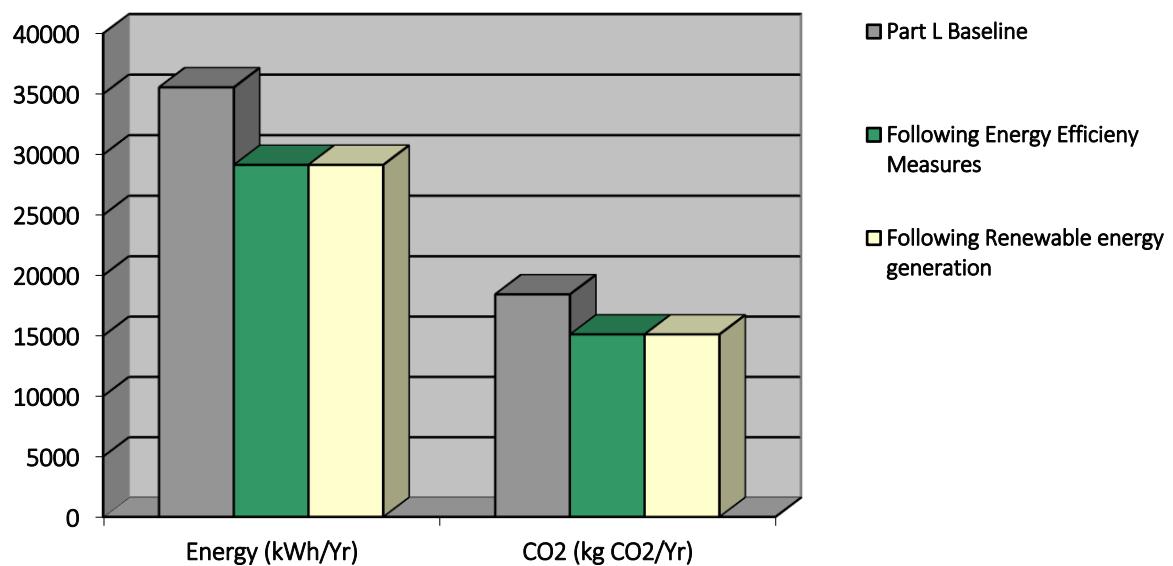


On-site renewables

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from LZC technologies.

Energy saving from the use of renewables (kWh)	-
Saving on residual emissions from the use of renewables (kg)	-
Saving on residual emissions from the use of renewables (%)	-

The chart below illustrates the improvements over the Part L Compliant Baseline:



2.3.4 Manchester City Council Policy and Targets Summary

With regards to the Manchester City Council's planning documents policy and targets (outlined in section 2.2.1 to 2.2.3) the table below details how the Sustainable Design Strategy (outlined in section 2.3.1) achieves the current planning policy requirements and targets.

Planning Document:	Sustainable Design Strategy
Manchester Council's Core Strategy 2012-2027	The Sustainable Design Strategy achieves a 18.0% reduction in carbon emissions over Part L 2013 - exceeding the EN6 documents carbon target of 9% over Part L 2013.
Climate Change and Low Emission Strategies 2016-2020	The Sustainable Design Strategy achieves a 18.0% reduction in carbon emissions over Part L 2013 – exceeding the documents carbon target of 48% over 1990 Emissions.
Manchester: A Certain Future	The Sustainable Design Strategy achieves a 18.0% reduction in carbon emissions over Part L 2013 – exceeding the documents carbon target of 10% over Part L 2013.

As a result of the sustainable design parameters outlined within section 2.3.1 and the energy and CO2 reduction figures summarised above, the development of 4 flats at 17 Piccadilly achieves a total reduction of **18.0%** in carbon emissions over Part L 2013.

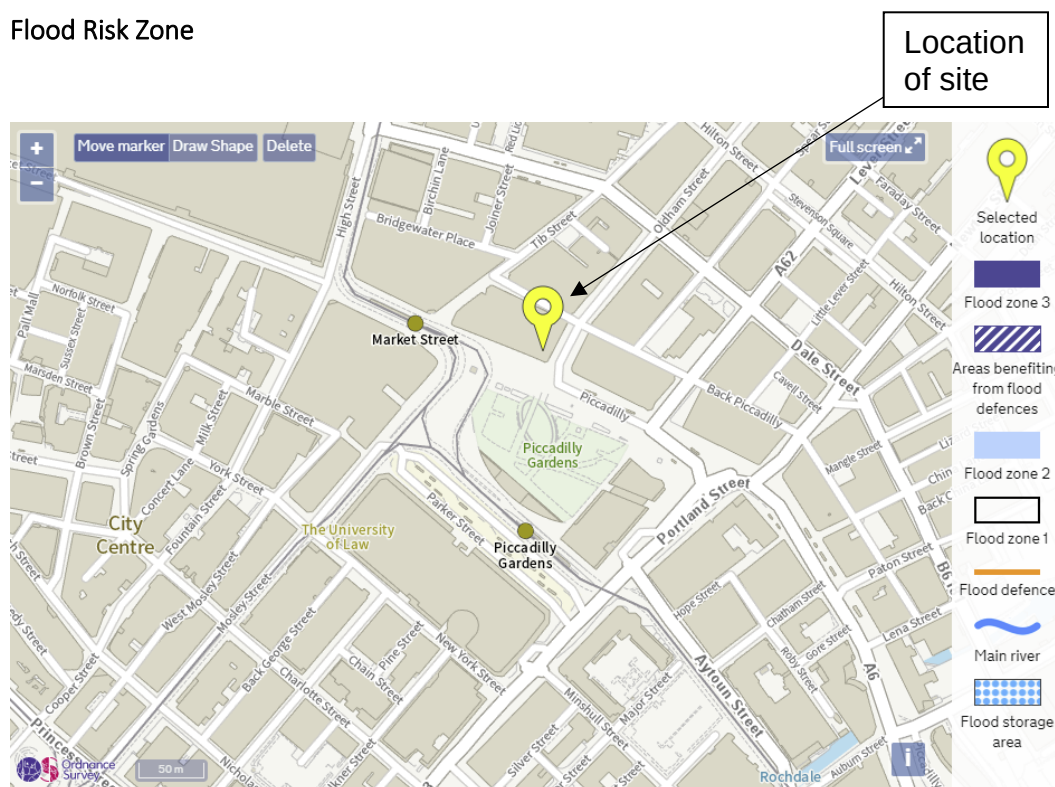


2.4 Adaptation to Climate Change

In addition to the primary building design and fabric, many other issues that will influence creating a Sustainable Development, including flood prevention, material use, waste minimisation and transport. All of these issues feature regularly within the separate climate change action plans, outlined within section 2.2, as areas that Manchester is aiming to significantly improve on in order to become a more carbon neutral and clean city.

All of the sections of creating a sustainable development should be taken into consideration from the start of the development and promoted throughout the building construction on site in order to maximise their benefits. Additionally, features which enable more efficient usage should also be specified to encourage the building users to maintain efficient use once construction has been completed.

Flood Risk Zone



The above map and snippet have been taken from a Government licences flood risk map for central Manchester. It can clearly be seen that the site is located within flood risk zone 1 and therefore has minimal to no risk of flooding.

Internal Water Efficiency

Part G of the Building Regulations requires all new serviced apartments to have an internal water consumption of no greater than 110 litres / person / day, unless specified to be less. Therefore, fittings proposed should have low flow rates, capacities, effective flush volumes etc. Example targets for these to achieve the required internal consumption are as follows:

Appliance	Unit of measure	Amount (litres)
WC (Dual flush)	Full flush volume	4
WC (Dual flush)	Part flush volume	2.6
Taps (excluding kitchen)	Flow rate l/min	7
Kitchen taps	Flow rate l/min	7
Shower	Flow rate l/min	9
Washing Machine	Litres / kg dry load	8.17
Dishwasher	Litres / place setting	1.25

The above rates will achieve a total internal water consumption of 106.62 without a bath present.

Sustainable Drainage Systems (SUDs)

This section of a sustainable design has been deemed inapplicable to the proposed scheme, as it has already been evidenced that the site exists on a low flood risk area. In addition, the proposal is within an existing development, resulting in no increase of the total buildings footprint. As a result there will be no impact on the amount or rate of surface water run-off from the site.

Biodiversity

The proposed development will have no impact on the existing biodiversity levels within the site or its immediate proximity due to the proposal being a straight conversion with no extension of space, no new external building works and no alterations to existing facades. As a further result of this, the proposal does also not present any opportunities for biodiversity enhancement or additional habitat creation. However care will be taken throughout, in order to protect and preserve the existing ecology near to the site.



Waste Management

Manchester City Council's Waste Storage and Collection Guidance for New Developments 2017 encourages all new developments to incorporate a waste management strategy into the build at the earliest stage possible.

It is assumed that bin store will have a number of waste and recycling bins.

Materials

The construction of new buildings and building elements has a large environmental impact in terms of both, energy and embodied carbon of new materials. Therefore, Manchester Council, through Policy E1.6 of the Unitary Development Plan (UDP) have required all new developments to use environmentally friendly materials, where possible, and encourages the use of recycled building materials. This information should also be incorporated into the SWMP mentioned in the previous subsection (Waste Management) as a means of promoting the re-using and recycling of materials.

Where new materials are to be used, careful consideration of their environmental impact should be taken. This can be achieved by ensuring that only materials that score well under The Green Guide to Specification. This useful online tool can be used as a reference that provides guidance on the relative environmental impacts for a wide range of different building specifications. The BRE's Environmental Profile Methodology determines the Life Cycle Assessment (LCA) of materials, which is what the Guide's specifications are based on.

In order to take full advantage of low impact materials, elements key to the scheme should be specified to achieve ratings of between A+ and C under The Green Guide's ratings. Insulation materials that are specified will also have a global warming potential (GWP) of 5 or less, with an ODP of 0. Additionally, 100% of all timber used as part of the scheme will be responsibly sourced from suppliers that are either Forest Stewardship Council (FSC) accredited, Programme for the Endorsement of Forestry Certification accredited, or a similar recognised accreditation body.

To further promote embodied energy and carbon savings, the scheme will first prioritise the reusing of any demolished materials within the proposed, however if this is not possible secondary priority must be given to the redirecting from landfill; in line with the waste hierarchy.

Finally, in addition to the above policy points, the development is also recommended to register with the Considerate Constructors Scheme, or a similar approved scheme.



Health & Wellbeing

A daylighting assessment should be carried out on all living, kitchen, dining and main bedrooms in order to ensure that they receive adequate levels of day lighting. This is to ensure that there is less reliance on the need for artificial lighting. For when artificial lighting is required, the development must ensure that all fittings, throughout the development, are LED fittings.

Sustainable Transport

A key message from all climate change adaptation plans (as mentioned in section 2.2), specifically Our Manchester Strategy 2016-2025, The Zero Carbon Framework (formulated by the Manchester Climate Change Board) and Manchester City Council's Core Strategy 2012-2027, is the need to increase the proportion of cycling, walking and public transport journeys. This is due to it providing both environmental and social benefits through the reducing of emissions, improving air quality and promoting a more active lifestyle.

The proposed development acknowledges the benefits associated with these forms of sustainable transport and is therefore providing cycle storage and also no car parking spaces, thereby encouraging all residents to commute in a sustainable manner.

Further to providing significant cycle provision and electric car ports, the site is located in central Manchester close and is within a 10 minute walk to Manchester Piccadilly train station and Market Street tram stop where journeys can be made to all of Manchester and beyond. This proximity to a plethora of transports node with such a range of travel possibilities further reduces the reliance on cars and the negative environmental impacts associated.



2. Feasibility Assessment of Renewable Energy and Low Carbon Technologies

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at the moment. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which the sun heats a fluid. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar hot water panels could be used however, PV will provide slightly better savings and avoid the need for water storage cylinders when compared.

Renewable Technology Not Chosen.

Photovoltaic Panels (PV)

Photovoltaic modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, very small amounts of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionize the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

A PV array can be mounted on the suitable roof space. However the preferred option is to progress a VRV system and communal heat pump.

Renewable Technology Not Chosen.



Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP). Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Ground source heat pumps would not be suitable due to the lack of land space around the properties and the associated costs.

Renewable Technology Not Viable

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°C which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°C is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

A Heat Pump system would be a good choice on an individual basis to provide heating and cooling to each serviced apartment however it is not proposed at this stage.

Renewable Technology Not Chosen



Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries.

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A communal biomass system would not be feasible for this development due to the expense associated with the necessary output to heat the serviced apartment scheme.

Renewable Technology Not Chosen

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy that is then converted to electricity. Turbines are available in a range of sizes and designs and can either be free-standing, mounted on a building or integrated into a building structure.

The wind speed in the area is under the advised minimum and the built-up area means that a wind turbine would not be feasible.

Renewable Technology Not Viable



3. Conclusion

This statement has assessed the proposed development at the 17 Piccadilly site against the relevant climate change and sustainability policies and targets, as outlined within: the Manchester City Council Core Strategy (July 2012), Our Manchester Strategy, Manchester: A Certain Future and The Zero Carbon Framework, through the following of the energy hierarchy, the modelling of apartments in the FSAP 2012 software and addressing all aspects of a sustainable development.

As part of this process, the development was designed with a fabric first approach; with U-values, and ventilation targets all aspiring to achieve and exceed Building Regulations Part L 2013 standards where possible, whilst ensuring that all additional measures to reduce final emissions are undertaken. This approach demonstrates a low energy design concept, involving targeting lower limiting values and thus leading to higher energy performance targets.

Furthermore, an LZC feasibility assessment was carried out, with all suitable technologies investigated for their suitability to the site and development. The assessment determined that no additional technologies would be required due to sufficient emissions savings already being experienced at the lean stage. This results in a total carbon reduction of **18.0%**. In addition to this renewable technology provision.

As a result of the above, the proposed sustainable design strategy allows the development to comply with Manchester City Council's planning policy requirement and is in line with all targets put forward in their planning documents.



Appendix A – Energy Demand Assessment – 17 Piccadilly, Manchester

House Type	Flat 1	Flat 2	Flat 3	Flat 4	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
BASELINE Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	7022.44	8069.97	3884.46	7995.42	26972.3	0.519	13998.6
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	1834.96	2008.78	1559.96	1826.75	7230.5	0.519	3752.6
Electricity Pumps Fans Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Electricity Lighting Requirement (DER)	328.54	434.01	254.22	325.04	1341.8	0.519	696.4
TOTAL PER DEVELOPMENT					35544.6		18447.6
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	5225.54	6351.03	3202.65	6169.72	20948.9	0.519	10872.5
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	1734.17	1907.98	1473.09	1725.96	6841.2	0.519	3550.6
Electricity Pumps Fans Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Electricity Lighting Requirement (DER)	328.54	440.36	260.48	325.04	1354.4	0.519	702.9
TOTAL PER DEVELOPMENT					29144.6		15126.0
FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	5225.54	6351.03	3202.65	6169.72	20948.9	0.519	10872.5
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	1734.17	1907.98	1473.09	1725.96	6841.2	0.519	3550.6
Electricity Pumps Fans Requirement (DER)	0	0	0	0	0.0	0.519	0.0
Electricity Lighting Requirement (DER)	328.54	440.36	260.48	325.04	1354.4	0.519	702.9
PV Energy Produced (DER)					0.0	0.519	0.0
TOTAL PER DEVELOPMENT					29144.6		15126.0



Predicted Energy Assessment



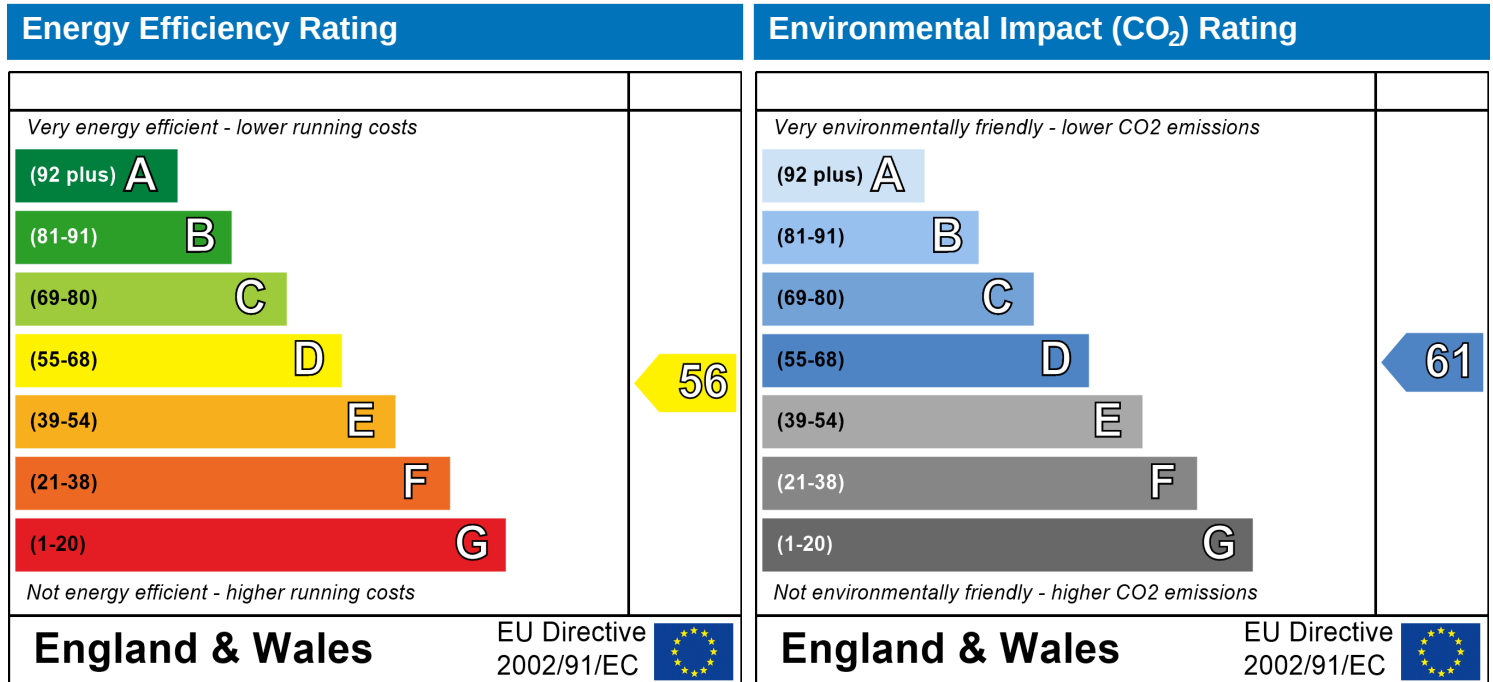
Flat 1
17 Piccadilly
Manchester
M1 1LS

Dwelling type:
Date of assessment:
Produced by:
Total floor area:

Mid floor Flat
19 May 2021
Daniel Watt
75 m²

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO₂) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

SAP Input

Property Details: Flat 1 - Proposed

Address: Flat 1, 17 Piccadilly, Manchester, M1 1LS
Located in: England
Region: Thames valley
UPRN:
Date of assessment: 19 May 2021
Date of certificate: 19 May 2021
Assessment type: New dwelling created by change of use
Transaction type: None of the above
Tenure type: Unknown
Related party disclosure: Employed by the professional dealing with the property transaction
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 477

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: Floor area: Storey height:
 Floor 0 75 m² 2.7 m
Living area: 37.9 m² (fraction 0.505)
Front of dwelling faces: North

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
South glazing	SAP 2012	Windows	Secondary glazing	No	Wood
SE glazing	SAP 2012	Windows	Secondary glazing	No	Wood
East glazing	SAP 2012	Windows	Secondary glazing	No	Wood

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
South glazing	16mm or more	0.7	0.76	2.4	15.74	1
SE glazing	16mm or more	0.7	0.76	2.4	1.48	1
East glazing	16mm or more	0.7	0.76	2.4	6.18	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
South glazing		Existing walls	South	7.87	2
SE glazing		Existing walls	South East	0.74	2
East glazing		Existing walls	East	3.09	2

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Existing walls	48.33	23.4	24.93	1.5	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: No information on thermal bridging (y=0.15) (y =0.15)

Ventilation:

Pressure test: No (Assumed)

SAP Input

Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	15

Main heating system:

Main heating system:	Room heaters Electric (direct acting) room heaters Fuel: Electricity Info Source: SAP Tables SAP Table: 691 Panel, convector or radiant heaters Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Room-sealed Boiler interlock: Yes
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Main heating Control:

Main heating Control:	Programmer and appliance thermostats Control code: 2603
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Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	Electric immersion (on-peak or off-peak) Water code: 903 Fuel :Electricity Hot water cylinder Cylinder volume: 150 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: False Cylinderstat: True Cylinder in heated space: True Solar panel: False
----------------	--

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	No
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: Flat 1 - Proposed

Address : Flat 1, 17 Piccadilly, Manchester, M1 1LS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	75 (1a)	2.7 (2a)	202.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	202.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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 <i>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</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.85 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
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) =		0.72 (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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SAP WorkSheet: New dwelling created by change of use

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

0.92	0.9	0.88	0.79	0.78	0.69	0.69	0.67	0.72	0.78	0.81	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) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (24d)

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

(25)m= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			15.74	$\times 1/[1/(2.4) + 0.04] =$	34.47		(27)
Windows Type 2			1.48	$\times 1/[1/(2.4) + 0.04] =$	3.24		(27)
Windows Type 3			6.18	$\times 1/[1/(2.4) + 0.04] =$	13.53		(27)
Walls	48.33	23.4	24.93	$\times 1.5 =$	37.4		(29)
Total area of elements, m²			48.33				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 88.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 2742.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.25 (36)

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

Total fabric heat loss (33) + (36) = 95.89 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	61.68	60.59	59.51	54.46	53.51	49.11	49.11	48.29	50.8	53.51	55.42	57.42

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

(39)m= 157.57 156.47 155.4 150.34 149.4 144.99 144.99 144.18 146.69 149.4 151.31 153.31
Average = Sum(39)_{1...12} /12= 150.34 (39)

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

(40)m= 2.1 2.09 2.07 2 1.99 1.93 1.93 1.92 1.96 1.99 2.02 2.04
Average = Sum(40)_{1...12} /12= 2 (40)

SAP WorkSheet: New dwelling created by change of use

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, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 90.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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 $V_{d,m} = \text{factor from Table 1c} \times (43)$													
(44)m=	99.31	95.69	92.08	88.47	84.86	81.25	81.25	84.86	88.47	92.08	95.69	99.31	
Total = Sum(44) _{1...12} =												1083.33	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	147.27	128.8	132.91	115.87	111.18	95.94	88.91	102.02	103.24	120.32	131.33	142.62	
Total = Sum(45) _{1...12} =												1420.42	(45)

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

(46)m=	22.09	19.32	19.94	17.38	16.68	14.39	13.34	15.3	15.49	18.05	19.7	21.39	(46)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) \times (49) = 150 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) \times (51) \times (52) \times (53) = 0.86 (54)

Enter (50) or (54) in (55) 0.86 (55)

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

(56)m=	26.65	24.07	26.65	25.79	26.65	25.79	26.65	26.65	25.79	26.65	25.79	26.65	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	26.65	24.07	26.65	25.79	26.65	25.79	26.65	26.65	25.79	26.65	25.79	26.65	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(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 $(61)m = (60) \div 365 \times (41)m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

SAP WorkSheet: New dwelling created by change of use

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

(62)m=

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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=

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1734.17

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

70.28	62.08	65.51	59.16	58.29	52.53	50.88	55.24	54.96	61.32	64.3	68.74
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (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

(66)m=

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67

 (66)

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

(67)m=

46.51	41.31	33.59	25.43	19.01	16.05	17.34	22.54	30.26	38.42	44.84	47.8
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

 (67)

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

(68)m=

311.46	314.69	306.54	289.2	267.32	246.75	233.01	229.77	237.92	255.26	277.14	297.71
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

94.47	92.38	88.05	82.16	78.34	72.96	68.39	74.25	76.33	82.42	89.3	92.39
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (72)

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

(73)m=

551.18	547.13	526.94	495.55	463.42	434.51	417.49	425.31	443.26	474.85	510.04	536.66
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>44.75</td></tr></table>	44.75	(76)
0.77																			
6.18																			
19.64																			
0.76																			
0.7																			
44.75																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>87.54</td></tr></table>	87.54	(76)
0.77																			
6.18																			
38.42																			
0.76																			
0.7																			
87.54																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>144.16</td></tr></table>	144.16	(76)
0.77																			
6.18																			
63.27																			
0.76																			
0.7																			
144.16																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>210.25</td></tr></table>	210.25	(76)
0.77																			
6.18																			
92.28																			
0.76																			
0.7																			
210.25																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>113.09</td></tr></table>	113.09	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>257.67</td></tr></table>	257.67	(76)
0.77																			
6.18																			
113.09																			
0.76																			
0.7																			
257.67																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>115.77</td></tr></table>	115.77	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>263.77</td></tr></table>	263.77	(76)
0.77																			
6.18																			
115.77																			
0.76																			
0.7																			
263.77																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>110.22</td></tr></table>	110.22	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>251.12</td></tr></table>	251.12	(76)
0.77																			
6.18																			
110.22																			
0.76																			
0.7																			
251.12																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>94.68</td></tr></table>	94.68	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>215.71</td></tr></table>	215.71	(76)
0.77																			
6.18																			
94.68																			
0.76																			
0.7																			
215.71																			

SAP WorkSheet: New dwelling created by change of use

East	0.9x	0.77	x	6.18	x	73.59	x	0.76	x	0.7	=	167.67	(76)
East	0.9x	0.77	x	6.18	x	45.59	x	0.76	x	0.7	=	103.87	(76)
East	0.9x	0.77	x	6.18	x	24.49	x	0.76	x	0.7	=	55.8	(76)
East	0.9x	0.77	x	6.18	x	16.15	x	0.76	x	0.7	=	36.8	(76)
Southeast	0.9x	0.77	x	1.48	x	36.79	x	0.76	x	0.7	=	20.08	(77)
Southeast	0.9x	0.77	x	1.48	x	62.67	x	0.76	x	0.7	=	34.2	(77)
Southeast	0.9x	0.77	x	1.48	x	85.75	x	0.76	x	0.7	=	46.79	(77)
Southeast	0.9x	0.77	x	1.48	x	106.25	x	0.76	x	0.7	=	57.98	(77)
Southeast	0.9x	0.77	x	1.48	x	119.01	x	0.76	x	0.7	=	64.94	(77)
Southeast	0.9x	0.77	x	1.48	x	118.15	x	0.76	x	0.7	=	64.47	(77)
Southeast	0.9x	0.77	x	1.48	x	113.91	x	0.76	x	0.7	=	62.15	(77)
Southeast	0.9x	0.77	x	1.48	x	104.39	x	0.76	x	0.7	=	56.96	(77)
Southeast	0.9x	0.77	x	1.48	x	92.85	x	0.76	x	0.7	=	50.66	(77)
Southeast	0.9x	0.77	x	1.48	x	69.27	x	0.76	x	0.7	=	37.8	(77)
Southeast	0.9x	0.77	x	1.48	x	44.07	x	0.76	x	0.7	=	24.05	(77)
Southeast	0.9x	0.77	x	1.48	x	31.49	x	0.76	x	0.7	=	17.18	(77)
South	0.9x	0.77	x	15.74	x	46.75	x	0.76	x	0.7	=	271.3	(78)
South	0.9x	0.77	x	15.74	x	76.57	x	0.76	x	0.7	=	444.32	(78)
South	0.9x	0.77	x	15.74	x	97.53	x	0.76	x	0.7	=	565.99	(78)
South	0.9x	0.77	x	15.74	x	110.23	x	0.76	x	0.7	=	639.69	(78)
South	0.9x	0.77	x	15.74	x	114.87	x	0.76	x	0.7	=	666.59	(78)
South	0.9x	0.77	x	15.74	x	110.55	x	0.76	x	0.7	=	641.5	(78)
South	0.9x	0.77	x	15.74	x	108.01	x	0.76	x	0.7	=	626.79	(78)
South	0.9x	0.77	x	15.74	x	104.89	x	0.76	x	0.7	=	608.7	(78)
South	0.9x	0.77	x	15.74	x	101.89	x	0.76	x	0.7	=	591.24	(78)
South	0.9x	0.77	x	15.74	x	82.59	x	0.76	x	0.7	=	479.24	(78)
South	0.9x	0.77	x	15.74	x	55.42	x	0.76	x	0.7	=	321.58	(78)
South	0.9x	0.77	x	15.74	x	40.4	x	0.76	x	0.7	=	234.43	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

336.13	566.06	756.94	907.91	989.2	969.75	940.07	881.37	809.57	620.91	401.43	288.41
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

 (83)

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

(84)m=

887.31	1113.18	1283.88	1403.47	1452.62	1404.26	1357.55	1306.68	1252.82	1095.76	911.46	825.07
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.98	0.96	0.92	0.86	0.75	0.6	0.45	0.48	0.68	0.88	0.96	0.98

 (86)

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

(87)m=

19.12	19.45	19.85	20.33	20.68	20.9	20.97	20.96	20.83	20.36	19.67	19.1
-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

 (87)

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

(88)m=

19.27	19.28	19.29	19.33	19.34	19.38	19.38	19.39	19.36	19.34	19.32	19.3
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

 (88)

SAP WorkSheet: New dwelling created by change of use

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

(89)m=	0.97	0.94	0.9	0.81	0.67	0.47	0.29	0.32	0.56	0.83	0.95	0.98	(89)
--------	------	------	-----	------	------	------	------	------	------	------	------	------	------

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

(90)m=	16.93	17.4	17.98	18.64	19.07	19.32	19.37	19.37	19.26	18.71	17.76	16.92	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.51 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	18.04	18.43	18.93	19.5	19.88	20.12	20.18	20.18	20.05	19.55	18.73	18.02	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.04	18.43	18.93	19.5	19.88	20.12	20.18	20.18	20.05	19.55	18.73	18.02	(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	0.94	0.89	0.81	0.7	0.53	0.37	0.4	0.62	0.84	0.94	0.97	(94)
--------	------	------	------	------	-----	------	------	-----	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	856.5	1041.83	1144.12	1142.46	1014.72	744.64	506.52	528.16	774.18	918.75	857.99	801.49	(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=	2164.31	2117.66	1930.83	1592.98	1222.28	800.4	518.95	544.59	873.04	1336.35	1759.48	2119.29	(97)
--------	---------	---------	---------	---------	---------	-------	--------	--------	--------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	973.01	722.95	585.32	324.37	154.42	0	0	0	0	310.69	649.08	980.45	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												4700.29	(98)

Space heating requirement in kWh/m²/year

62.67	(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 1 100 (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)

973.01	722.95	585.32	324.37	154.42	0	0	0	0	310.69	649.08	980.45
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

973.01	722.95	585.32	324.37	154.42	0	0	0	0	310.69	649.08	980.45		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												4700.29	(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		
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

SAP WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
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Efficiency of water heater

100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1734.17 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

4700.29

Water heating fuel used

1734.17

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

328.54 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

6763 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19 x 0.01 =	619.97 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19 x 0.01 =	0 (242)
Water heating (electric off-peak tariff)			
High-rate fraction (Table 13, or Appendix F for electric CPSU)		1	(243)
Low-rate fraction	1.0 - (243) =	0	(244)
High-rate cost	(219) x (243) x	13.19 x 0.01 =	228.74 (245)
Low-rate cost	(219) x (244) x	13.19 x 0.01 =	0 (246)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19 x 0.01 =	43.33 (250)
Additional standing charges (Table 12)			0 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		892.04 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)	0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] = 3.12 (257)
SAP rating (Section 12)	56.45 (258)

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

SAP WorkSheet: New dwelling created by change of use

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	=	2439.45 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	900.03 (264)
Space and water heating	(261) + (262) + (263) + (264) =			3339.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0 (267)
Electricity for lighting	(232) x	0.519	=	170.51 (268)
Total CO2, kg/year		sum of (265)...(271) =		3510 (272)
CO2 emissions per m²		(272) ÷ (4) =		46.8 (273)
El rating (section 14)				61 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	=	14429.9 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	5323.89 (264)
Space and water heating	(261) + (262) + (263) + (264) =			19753.79 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0 (267)
Electricity for lighting	(232) x	0	=	1008.63 (268)
'Total Primary Energy		sum of (265)...(271) =		20762.42 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		276.83 (273)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: Flat 1 - Proposed

Address : Flat 1, 17 Piccadilly, Manchester, M1 1LS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	75 (1a)	2.7 (2a)	202.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	202.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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 <i>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</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.85 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
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) =		0.72 (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
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DER WorkSheet: New dwelling created by change of use

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

0.92	0.9	0.88	0.79	0.78	0.69	0.69	0.67	0.72	0.78	0.81	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) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (24d)

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

(25)m= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			15.74	$x1/[1/(2.4)+0.04] =$	34.47		(27)
Windows Type 2			1.48	$x1/[1/(2.4)+0.04] =$	3.24		(27)
Windows Type 3			6.18	$x1/[1/(2.4)+0.04] =$	13.53		(27)
Walls	48.33	23.4	24.93	x 1.5 =	37.4		(29)
Total area of elements, m²			48.33				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 88.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 2742.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.25 (36)

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

Total fabric heat loss (33) + (36) = 95.89 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	61.68	60.59	59.51	54.46	53.51	49.11	49.11	48.29	50.8	53.51	55.42	57.42

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

(39)m= 157.57 156.47 155.4 150.34 149.4 144.99 144.99 144.18 146.69 149.4 151.31 153.31
Average = Sum(39)_{1...12} /12= 150.34 (39)

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

(40)m= 2.1 2.09 2.07 2 1.99 1.93 1.93 1.92 1.96 1.99 2.02 2.04
Average = Sum(40)_{1...12} /12= 2 (40)

DER WorkSheet: New dwelling created by change of use

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, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 90.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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 $V_{d,m}$ = factor from Table 1c x (43)													
(44)m=	99.31	95.69	92.08	88.47	84.86	81.25	81.25	84.86	88.47	92.08	95.69	99.31	
Total = Sum(44) _{1...12} =												1083.33	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	147.27	128.8	132.91	115.87	111.18	95.94	88.91	102.02	103.24	120.32	131.33	142.62	
Total = Sum(45) _{1...12} =												1420.42	(45)

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

(46)m=	22.09	19.32	19.94	17.38	16.68	14.39	13.34	15.3	15.49	18.05	19.7	21.39	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 150 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.86 (54)

Enter (50) or (54) in (55) 0.86 (55)

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

(56)m=	26.65	24.07	26.65	25.79	26.65	25.79	26.65	26.65	25.79	26.65	25.79	26.65	(56)
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If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	26.65	24.07	26.65	25.79	26.65	25.79	26.65	26.65	25.79	26.65	25.79	26.65	(57)
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Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(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 $(61)m = (60) \div 365 \times (41)m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

DER WorkSheet: New dwelling created by change of use

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

(62)m=

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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=

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1734.17

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

70.28	62.08	65.51	59.16	58.29	52.53	50.88	55.24	54.96	61.32	64.3	68.74
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06

 (66)

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

(67)m=

18.6	16.52	13.44	10.17	7.6	6.42	6.94	9.02	12.1	15.37	17.94	19.12
------	-------	-------	-------	-----	------	------	------	------	-------	-------	-------

 (67)

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

(68)m=

208.68	210.84	205.38	193.77	179.1	165.32	156.11	153.95	159.4	171.02	185.69	199.47
--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------

 (68)

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

(69)m=

34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

94.47	92.38	88.05	82.16	78.34	72.96	68.39	74.25	76.33	82.42	89.3	92.39
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (72)

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

(73)m=

380.16	378.16	365.29	344.52	323.47	303.12	289.85	295.63	306.25	327.23	351.34	369.4
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>44.75</td></tr></table>	44.75	(76)
0.77																			
6.18																			
19.64																			
0.76																			
0.7																			
44.75																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>87.54</td></tr></table>	87.54	(76)
0.77																			
6.18																			
38.42																			
0.76																			
0.7																			
87.54																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>144.16</td></tr></table>	144.16	(76)
0.77																			
6.18																			
63.27																			
0.76																			
0.7																			
144.16																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>210.25</td></tr></table>	210.25	(76)
0.77																			
6.18																			
92.28																			
0.76																			
0.7																			
210.25																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>113.09</td></tr></table>	113.09	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>257.67</td></tr></table>	257.67	(76)
0.77																			
6.18																			
113.09																			
0.76																			
0.7																			
257.67																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>115.77</td></tr></table>	115.77	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>263.77</td></tr></table>	263.77	(76)
0.77																			
6.18																			
115.77																			
0.76																			
0.7																			
263.77																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>110.22</td></tr></table>	110.22	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>251.12</td></tr></table>	251.12	(76)
0.77																			
6.18																			
110.22																			
0.76																			
0.7																			
251.12																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>94.68</td></tr></table>	94.68	x	<table><tr><td>0.76</td></tr></table>	0.76	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>215.71</td></tr></table>	215.71	(76)
0.77																			
6.18																			
94.68																			
0.76																			
0.7																			
215.71																			

DER WorkSheet: New dwelling created by change of use

East	0.9x	0.77	x	6.18	x	73.59	x	0.76	x	0.7	=	167.67	(76)
East	0.9x	0.77	x	6.18	x	45.59	x	0.76	x	0.7	=	103.87	(76)
East	0.9x	0.77	x	6.18	x	24.49	x	0.76	x	0.7	=	55.8	(76)
East	0.9x	0.77	x	6.18	x	16.15	x	0.76	x	0.7	=	36.8	(76)
Southeast	0.9x	0.77	x	1.48	x	36.79	x	0.76	x	0.7	=	20.08	(77)
Southeast	0.9x	0.77	x	1.48	x	62.67	x	0.76	x	0.7	=	34.2	(77)
Southeast	0.9x	0.77	x	1.48	x	85.75	x	0.76	x	0.7	=	46.79	(77)
Southeast	0.9x	0.77	x	1.48	x	106.25	x	0.76	x	0.7	=	57.98	(77)
Southeast	0.9x	0.77	x	1.48	x	119.01	x	0.76	x	0.7	=	64.94	(77)
Southeast	0.9x	0.77	x	1.48	x	118.15	x	0.76	x	0.7	=	64.47	(77)
Southeast	0.9x	0.77	x	1.48	x	113.91	x	0.76	x	0.7	=	62.15	(77)
Southeast	0.9x	0.77	x	1.48	x	104.39	x	0.76	x	0.7	=	56.96	(77)
Southeast	0.9x	0.77	x	1.48	x	92.85	x	0.76	x	0.7	=	50.66	(77)
Southeast	0.9x	0.77	x	1.48	x	69.27	x	0.76	x	0.7	=	37.8	(77)
Southeast	0.9x	0.77	x	1.48	x	44.07	x	0.76	x	0.7	=	24.05	(77)
Southeast	0.9x	0.77	x	1.48	x	31.49	x	0.76	x	0.7	=	17.18	(77)
South	0.9x	0.77	x	15.74	x	46.75	x	0.76	x	0.7	=	271.3	(78)
South	0.9x	0.77	x	15.74	x	76.57	x	0.76	x	0.7	=	444.32	(78)
South	0.9x	0.77	x	15.74	x	97.53	x	0.76	x	0.7	=	565.99	(78)
South	0.9x	0.77	x	15.74	x	110.23	x	0.76	x	0.7	=	639.69	(78)
South	0.9x	0.77	x	15.74	x	114.87	x	0.76	x	0.7	=	666.59	(78)
South	0.9x	0.77	x	15.74	x	110.55	x	0.76	x	0.7	=	641.5	(78)
South	0.9x	0.77	x	15.74	x	108.01	x	0.76	x	0.7	=	626.79	(78)
South	0.9x	0.77	x	15.74	x	104.89	x	0.76	x	0.7	=	608.7	(78)
South	0.9x	0.77	x	15.74	x	101.89	x	0.76	x	0.7	=	591.24	(78)
South	0.9x	0.77	x	15.74	x	82.59	x	0.76	x	0.7	=	479.24	(78)
South	0.9x	0.77	x	15.74	x	55.42	x	0.76	x	0.7	=	321.58	(78)
South	0.9x	0.77	x	15.74	x	40.4	x	0.76	x	0.7	=	234.43	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

336.13	566.06	756.94	907.91	989.2	969.75	940.07	881.37	809.57	620.91	401.43	288.41
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

 (83)

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

(84)m=

716.29	944.22	1122.23	1252.44	1312.67	1272.86	1229.92	1177	1115.82	948.14	752.77	657.81
--------	--------	---------	---------	---------	---------	---------	------	---------	--------	--------	--------

 (84)

7. Mean internal temperature (heating season)

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

21 (85)

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

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.97	0.94	0.89	0.79	0.64	0.49	0.53	0.73	0.91	0.98	0.99

 (86)

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

(87)m=

18.95	19.29	19.72	20.23	20.62	20.87	20.96	20.95	20.79	20.25	19.52	18.93
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (87)

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

(88)m=

19.27	19.28	19.29	19.33	19.34	19.38	19.38	19.39	19.36	19.34	19.32	19.3
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

 (88)

DER WorkSheet: New dwelling created by change of use

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

(89)m=	0.98	0.96	0.92	0.85	0.71	0.51	0.32	0.36	0.61	0.87	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	16.68	17.18	17.8	18.52	19.01	19.31	19.37	19.37	19.23	18.58	17.55	16.68	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.51 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	17.83	18.24	18.77	19.39	19.82	20.1	20.17	20.17	20.01	19.43	18.55	17.81	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	17.83	18.24	18.77	19.39	19.82	20.1	20.17	20.17	20.01	19.43	18.55	17.81	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.92	0.85	0.74	0.57	0.41	0.44	0.67	0.88	0.96	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	701.68	902.55	1029.2	1061.36	968.34	727.63	501.83	521.76	743.51	831.01	724.64	647.34	(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=	2131.44	2087.93	1906.42	1576.58	1213.51	797.49	518.13	543.49	867.57	1318.6	1731.77	2087.29	(97)
--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	1063.74	796.58	652.65	370.96	182.41	0	0	0	0	362.76	725.13	1071.32	(98)
--------	---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 5225.54 \quad (98)$$

Space heating requirement in kWh/m²/year

$$69.67 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$100 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

1063.74	796.58	652.65	370.96	182.41	0	0	0	0	362.76	725.13	1071.32
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

1063.74	796.58	652.65	370.96	182.41	0	0	0	0	362.76	725.13	1071.32
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 5225.54 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

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

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

DER WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

173.91	152.87	159.56	141.66	137.83	121.73	115.55	128.67	129.03	146.96	157.12	169.27
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1734.17 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

5225.54

Water heating fuel used

1734.17

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

328.54 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

7288.25 (338)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	2712.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	900.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3612.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	170.51	(268)
Total CO2, kg/year			sum of (265)...(271) =	3782.6	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	50.43	(273)
El rating (section 14)				58	(274)

SAP WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: Flat 1 - Existing

Address : Flat 1, 17 Piccadilly, Manchester, M1 1LS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	75 (1a)	2.7 (2a)	202.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	202.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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 <i>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</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.85 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
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) =		0.72 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

SAP WorkSheet: New dwelling created by change of use

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

0.92	0.9	0.88	0.79	0.78	0.69	0.69	0.67	0.72	0.78	0.81	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) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (24d)

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

(25)m= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			15.74	$\times 1/[1/(4.8) + 0.04] =$	63.38		(27)
Windows Type 2			1.48	$\times 1/[1/(4.8) + 0.04] =$	5.96		(27)
Windows Type 3			6.18	$\times 1/[1/(4.8) + 0.04] =$	24.89		(27)
Walls	48.33	23.4	24.93	$\times 1.5 =$	37.4		(29)
Total area of elements, m²			48.33				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value}) + 0.04]$ 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) = 131.62 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 2742.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.25 (36)

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

Total fabric heat loss (33) + (36) = 138.87 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	61.68	60.59	59.51	54.46	53.51	49.11	49.11	48.29	50.8	53.51	55.42	57.42

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

(39)m= 200.56 199.46 198.38 193.33 192.38 187.98 187.98 187.17 189.68 192.38 194.3 196.3
Average = Sum(39)_{1...12} /12= 193.32 (39)

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

(40)m= 2.67 2.66 2.65 2.58 2.57 2.51 2.51 2.5 2.53 2.57 2.59 2.62
Average = Sum(40)_{1...12} /12= 2.58 (40)

SAP WorkSheet: New dwelling created by change of use

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, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 90.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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 $V_{d,m} = \text{factor from Table 1c} \times (43)$													
(44)m=	99.31	95.69	92.08	88.47	84.86	81.25	81.25	84.86	88.47	92.08	95.69	99.31	
Total = Sum(44) _{1...12} =												1083.33	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	147.27	128.8	132.91	115.87	111.18	95.94	88.91	102.02	103.24	120.32	131.33	142.62	
Total = Sum(45) _{1...12} =												1420.42	(45)

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

(46)m=	22.09	19.32	19.94	17.38	16.68	14.39	13.34	15.3	15.49	18.05	19.7	21.39	(46)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) \times (49) = 150 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) \times (51) \times (52) \times (53) = 1.14 (54)

Enter (50) or (54) in (55) 1.14 (55)

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

(56)m=	35.21	31.8	35.21	34.07	35.21	34.07	35.21	35.21	34.07	35.21	34.07	35.21	(56)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	35.21	31.8	35.21	34.07	35.21	34.07	35.21	35.21	34.07	35.21	34.07	35.21	(57)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(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 $(61)m = (60) \div 365 \times (41)m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

SAP WorkSheet: New dwelling created by change of use

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

(62)m=

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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=

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1834.96

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

77.13	68.27	72.36	65.79	65.14	59.16	57.73	62.09	61.58	68.17	70.93	75.59
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67	141.67

 (66)

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

(67)m=

46.51	41.31	33.59	25.43	19.01	16.05	17.34	22.54	30.26	38.42	44.84	47.8
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

 (67)

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

(68)m=

311.46	314.69	306.54	289.2	267.32	246.75	233.01	229.77	237.92	255.26	277.14	297.71
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

103.67	101.59	97.26	91.37	87.55	82.17	77.59	83.45	85.53	91.63	98.51	101.6
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

560.39	556.33	536.15	504.76	472.63	443.71	426.69	434.52	452.46	484.05	519.24	545.86
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>50.05</td></tr></table>	50.05	(76)
0.77																			
6.18																			
19.64																			
0.85																			
0.7																			
50.05																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>97.9</td></tr></table>	97.9	(76)
0.77																			
6.18																			
38.42																			
0.85																			
0.7																			
97.9																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>161.23</td></tr></table>	161.23	(76)
0.77																			
6.18																			
63.27																			
0.85																			
0.7																			
161.23																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>235.15</td></tr></table>	235.15	(76)
0.77																			
6.18																			
92.28																			
0.85																			
0.7																			
235.15																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>113.09</td></tr></table>	113.09	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>288.19</td></tr></table>	288.19	(76)
0.77																			
6.18																			
113.09																			
0.85																			
0.7																			
288.19																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>115.77</td></tr></table>	115.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>295.01</td></tr></table>	295.01	(76)
0.77																			
6.18																			
115.77																			
0.85																			
0.7																			
295.01																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>110.22</td></tr></table>	110.22	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>280.86</td></tr></table>	280.86	(76)
0.77																			
6.18																			
110.22																			
0.85																			
0.7																			
280.86																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>94.68</td></tr></table>	94.68	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>241.26</td></tr></table>	241.26	(76)
0.77																			
6.18																			
94.68																			
0.85																			
0.7																			
241.26																			

SAP WorkSheet: New dwelling created by change of use

East	0.9x	0.77	x	6.18	x	73.59	x	0.85	x	0.7	=	187.52	(76)
East	0.9x	0.77	x	6.18	x	45.59	x	0.85	x	0.7	=	116.17	(76)
East	0.9x	0.77	x	6.18	x	24.49	x	0.85	x	0.7	=	62.4	(76)
East	0.9x	0.77	x	6.18	x	16.15	x	0.85	x	0.7	=	41.16	(76)
Southeast	0.9x	0.77	x	1.48	x	36.79	x	0.85	x	0.7	=	22.45	(77)
Southeast	0.9x	0.77	x	1.48	x	62.67	x	0.85	x	0.7	=	38.25	(77)
Southeast	0.9x	0.77	x	1.48	x	85.75	x	0.85	x	0.7	=	52.33	(77)
Southeast	0.9x	0.77	x	1.48	x	106.25	x	0.85	x	0.7	=	64.84	(77)
Southeast	0.9x	0.77	x	1.48	x	119.01	x	0.85	x	0.7	=	72.63	(77)
Southeast	0.9x	0.77	x	1.48	x	118.15	x	0.85	x	0.7	=	72.1	(77)
Southeast	0.9x	0.77	x	1.48	x	113.91	x	0.85	x	0.7	=	69.51	(77)
Southeast	0.9x	0.77	x	1.48	x	104.39	x	0.85	x	0.7	=	63.7	(77)
Southeast	0.9x	0.77	x	1.48	x	92.85	x	0.85	x	0.7	=	56.66	(77)
Southeast	0.9x	0.77	x	1.48	x	69.27	x	0.85	x	0.7	=	42.27	(77)
Southeast	0.9x	0.77	x	1.48	x	44.07	x	0.85	x	0.7	=	26.89	(77)
Southeast	0.9x	0.77	x	1.48	x	31.49	x	0.85	x	0.7	=	19.22	(77)
South	0.9x	0.77	x	15.74	x	46.75	x	0.85	x	0.7	=	303.43	(78)
South	0.9x	0.77	x	15.74	x	76.57	x	0.85	x	0.7	=	496.94	(78)
South	0.9x	0.77	x	15.74	x	97.53	x	0.85	x	0.7	=	633.01	(78)
South	0.9x	0.77	x	15.74	x	110.23	x	0.85	x	0.7	=	715.44	(78)
South	0.9x	0.77	x	15.74	x	114.87	x	0.85	x	0.7	=	745.53	(78)
South	0.9x	0.77	x	15.74	x	110.55	x	0.85	x	0.7	=	717.47	(78)
South	0.9x	0.77	x	15.74	x	108.01	x	0.85	x	0.7	=	701.01	(78)
South	0.9x	0.77	x	15.74	x	104.89	x	0.85	x	0.7	=	680.78	(78)
South	0.9x	0.77	x	15.74	x	101.89	x	0.85	x	0.7	=	661.25	(78)
South	0.9x	0.77	x	15.74	x	82.59	x	0.85	x	0.7	=	535.99	(78)
South	0.9x	0.77	x	15.74	x	55.42	x	0.85	x	0.7	=	359.67	(78)
South	0.9x	0.77	x	15.74	x	40.4	x	0.85	x	0.7	=	262.19	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	375.93	633.09	846.58	1015.43	1106.34	1084.58	1051.39	985.74	905.44	694.44	448.96	322.56	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	936.32	1189.42	1382.72	1520.19	1578.97	1528.3	1478.08	1420.26	1357.9	1178.49	968.21	868.42	(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	0.96	0.93	0.87	0.78	0.65	0.51	0.54	0.73	0.89	0.96	0.98	(86)

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

(87)m=	18.61	18.96	19.43	19.99	20.45	20.78	20.92	20.9	20.68	20.06	19.25	18.58	(87)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(88)m=	18.92	18.93	18.94	18.98	18.98	19.02	19.02	19.02	19	18.98	18.97	18.95	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------

SAP WorkSheet: New dwelling created by change of use

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

(89)m=	0.97	0.94	0.9	0.82	0.69	0.5	0.3	0.33	0.59	0.84	0.95	0.97	(89)
--------	------	------	-----	------	------	-----	-----	------	------	------	------	------	------

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

(90)m=	16.02	16.52	17.17	17.96	18.53	18.91	19	19	18.81	18.07	16.95	15.99	(90)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.51 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	17.33	17.75	18.31	18.98	19.5	19.86	19.97	19.96	19.75	19.08	18.11	17.3	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	17.33	17.75	18.31	18.98	19.5	19.86	19.97	19.96	19.75	19.08	18.11	17.3	(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=	0.96	0.93	0.89	0.82	0.72	0.57	0.41	0.44	0.65	0.84	0.94	0.97	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	899.09	1107.08	1228.57	1246.84	1133.92	864	599.98	623.6	878.15	993.19	906.99	839.47	(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=	2612.98	2563.82	2343.52	1949.32	1500.6	988.06	633.76	666.78	1072.35	1630.52	2139.14	2571.35	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	1275.14	978.93	829.52	505.78	272.81	0	0	0	0	474.18	887.15	1288.52	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												6512.02	(98)

Space heating requirement in kWh/m²/year

86.83	(99)
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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

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

100	(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)

1275.14	978.93	829.52	505.78	272.81	0	0	0	0	474.18	887.15	1288.52
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$(211)m = \{ [(98)m \times (204)] \} \times 100 \div (206) \quad (211)$$

1275.14	978.93	829.52	505.78	272.81	0	0	0	0	474.18	887.15	1288.52
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} = 6512.02 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{ [(98)m \times (201)] \} \times 100 \div (208)$$

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

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

SAP WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1834.96 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

6512.02

Water heating fuel used

1834.96

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

328.54 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

8675.53 (238)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19 x 0.01 =	858.94 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19 x 0.01 =	0 (242)
Water heating (electric off-peak tariff)			
High-rate fraction (Table 13, or Appendix F for electric CPSU)		1	(243)
Low-rate fraction	1.0 - (243) =	0	(244)
High-rate cost	(219) x (243) x	13.19 x 0.01 =	242.03 (245)
Low-rate cost	(219) x (244) x	13.19 x 0.01 =	0 (246)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19 x 0.01 =	43.33 (250)
Additional standing charges (Table 12)			0 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		1144.3 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)	0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] = 4.01 (257)
SAP rating (Section 12)	44.08 (258)

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

SAP WorkSheet: New dwelling created by change of use

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	=	3379.74 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	952.34 (264)
Space and water heating	(261) + (262) + (263) + (264) =			4332.08 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0 (267)
Electricity for lighting	(232) x	0.519	=	170.51 (268)
Total CO2, kg/year		sum of (265)...(271) =		4502.6 (272)
CO2 emissions per m²		(272) ÷ (4) =		60.03 (273)
El rating (section 14)				50 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	=	19991.91 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	5633.33 (264)
Space and water heating	(261) + (262) + (263) + (264) =			25625.24 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0 (267)
Electricity for lighting	(232) x	0	=	1008.63 (268)
'Total Primary Energy		sum of (265)...(271) =		26633.87 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		355.12 (273)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: Daniel Watt
Software Name: Stroma FSAP 2012

Stroma Number: STRO026464
Software Version: Version: 1.0.5.41

Property Address: Flat 1 - Existing

Address : Flat 1, 17 Piccadilly, Manchester, M1 1LS

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	75	(1a) x	2.7	(2a) =	202.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			202.5

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0
Number of open flues	0	+	0	=	0
Number of intermittent fans				2	20
Number of passive vents				0	0
Number of flueless gas fires				0	0

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0
Additional infiltration		[(9)-1]x0.1 =	0
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>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</i>			0
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0
If no draught lobby, enter 0.05, else enter 0			0
Percentage of windows and doors draught stripped			0
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			15
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.85
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.72

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
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DER WorkSheet: New dwelling created by change of use

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

0.92	0.9	0.88	0.79	0.78	0.69	0.69	0.67	0.72	0.78	0.81	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) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (24d)

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

(25)m= 0.92 0.91 0.89 0.81 0.8 0.73 0.73 0.72 0.76 0.8 0.83 0.86 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			15.74	$\times 1/[1/(4.8) + 0.04] =$	63.38		(27)
Windows Type 2			1.48	$\times 1/[1/(4.8) + 0.04] =$	5.96		(27)
Windows Type 3			6.18	$\times 1/[1/(4.8) + 0.04] =$	24.89		(27)
Walls	48.33	23.4	24.93	$\times 1.5 =$	37.4		(29)
Total area of elements, m²			48.33				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 131.62 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 2742.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.25 (36)

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

Total fabric heat loss (33) + (36) = 138.87 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	61.68	60.59	59.51	54.46	53.51	49.11	49.11	48.29	50.8	53.51	55.42	57.42

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

(39)m= 200.56 199.46 198.38 193.33 192.38 187.98 187.98 187.17 189.68 192.38 194.3 196.3
Average = Sum(39)_{1...12} /12= 193.32 (39)

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

(40)m= 2.67 2.66 2.65 2.58 2.57 2.51 2.51 2.5 2.53 2.57 2.59 2.62
Average = Sum(40)_{1...12} /12= 2.58 (40)

DER WorkSheet: New dwelling created by change of use

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, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$ 90.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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 $V_{d,m} = \text{factor from Table 1c} \times (43)$													
(44)m=	99.31	95.69	92.08	88.47	84.86	81.25	81.25	84.86	88.47	92.08	95.69	99.31	
Total = Sum(44) _{1...12} =												1083.33	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	147.27	128.8	132.91	115.87	111.18	95.94	88.91	102.02	103.24	120.32	131.33	142.62	
Total = Sum(45) _{1...12} =												1420.42	(45)

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

(46)m=	22.09	19.32	19.94	17.38	16.68	14.39	13.34	15.3	15.49	18.05	19.7	21.39	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) × (49) = 150 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0.93 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) × (51) × (52) × (53) = 1.14 (54)

Enter (50) or (54) in (55) 1.14 (55)

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

(56)m=	35.21	31.8	35.21	34.07	35.21	34.07	35.21	35.21	34.07	35.21	34.07	35.21	(56)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	35.21	31.8	35.21	34.07	35.21	34.07	35.21	35.21	34.07	35.21	34.07	35.21	(57)
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Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month $(59)m = (58) \div 365 \times (41)m$

(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)
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Combi loss calculated for each month $(61)m = (60) \div 365 \times (41)m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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DER WorkSheet: New dwelling created by change of use

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

(62)m=

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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
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 (63)

Output from water heater

(64)m=

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1834.96

 (64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=

77.13	68.27	72.36	65.79	65.14	59.16	57.73	62.09	61.58	68.17	70.93	75.59
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 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06	118.06

 (66)

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

(67)m=

18.6	16.52	13.44	10.17	7.6	6.42	6.94	9.02	12.1	15.37	17.94	19.12
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 (67)

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

(68)m=

208.68	210.84	205.38	193.77	179.1	165.32	156.11	153.95	159.4	171.02	185.69	199.47
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 (68)

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

(69)m=

34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81	34.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45	-94.45
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

103.67	101.59	97.26	91.37	87.55	82.17	77.59	83.45	85.53	91.63	98.51	101.6
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

389.37	387.37	374.5	353.73	332.67	312.32	299.06	304.83	315.46	336.43	360.55	378.6
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>50.05</td></tr></table>	50.05	(76)
0.77																			
6.18																			
19.64																			
0.85																			
0.7																			
50.05																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>97.9</td></tr></table>	97.9	(76)
0.77																			
6.18																			
38.42																			
0.85																			
0.7																			
97.9																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>161.23</td></tr></table>	161.23	(76)
0.77																			
6.18																			
63.27																			
0.85																			
0.7																			
161.23																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>235.15</td></tr></table>	235.15	(76)
0.77																			
6.18																			
92.28																			
0.85																			
0.7																			
235.15																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>113.09</td></tr></table>	113.09	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>288.19</td></tr></table>	288.19	(76)
0.77																			
6.18																			
113.09																			
0.85																			
0.7																			
288.19																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>115.77</td></tr></table>	115.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>295.01</td></tr></table>	295.01	(76)
0.77																			
6.18																			
115.77																			
0.85																			
0.7																			
295.01																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>110.22</td></tr></table>	110.22	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>280.86</td></tr></table>	280.86	(76)
0.77																			
6.18																			
110.22																			
0.85																			
0.7																			
280.86																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>6.18</td></tr></table>	6.18	x	<table><tr><td>94.68</td></tr></table>	94.68	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>241.26</td></tr></table>	241.26	(76)
0.77																			
6.18																			
94.68																			
0.85																			
0.7																			
241.26																			

DER WorkSheet: New dwelling created by change of use

East	0.9x	0.77	x	6.18	x	73.59	x	0.85	x	0.7	=	187.52	(76)
East	0.9x	0.77	x	6.18	x	45.59	x	0.85	x	0.7	=	116.17	(76)
East	0.9x	0.77	x	6.18	x	24.49	x	0.85	x	0.7	=	62.4	(76)
East	0.9x	0.77	x	6.18	x	16.15	x	0.85	x	0.7	=	41.16	(76)
Southeast	0.9x	0.77	x	1.48	x	36.79	x	0.85	x	0.7	=	22.45	(77)
Southeast	0.9x	0.77	x	1.48	x	62.67	x	0.85	x	0.7	=	38.25	(77)
Southeast	0.9x	0.77	x	1.48	x	85.75	x	0.85	x	0.7	=	52.33	(77)
Southeast	0.9x	0.77	x	1.48	x	106.25	x	0.85	x	0.7	=	64.84	(77)
Southeast	0.9x	0.77	x	1.48	x	119.01	x	0.85	x	0.7	=	72.63	(77)
Southeast	0.9x	0.77	x	1.48	x	118.15	x	0.85	x	0.7	=	72.1	(77)
Southeast	0.9x	0.77	x	1.48	x	113.91	x	0.85	x	0.7	=	69.51	(77)
Southeast	0.9x	0.77	x	1.48	x	104.39	x	0.85	x	0.7	=	63.7	(77)
Southeast	0.9x	0.77	x	1.48	x	92.85	x	0.85	x	0.7	=	56.66	(77)
Southeast	0.9x	0.77	x	1.48	x	69.27	x	0.85	x	0.7	=	42.27	(77)
Southeast	0.9x	0.77	x	1.48	x	44.07	x	0.85	x	0.7	=	26.89	(77)
Southeast	0.9x	0.77	x	1.48	x	31.49	x	0.85	x	0.7	=	19.22	(77)
South	0.9x	0.77	x	15.74	x	46.75	x	0.85	x	0.7	=	303.43	(78)
South	0.9x	0.77	x	15.74	x	76.57	x	0.85	x	0.7	=	496.94	(78)
South	0.9x	0.77	x	15.74	x	97.53	x	0.85	x	0.7	=	633.01	(78)
South	0.9x	0.77	x	15.74	x	110.23	x	0.85	x	0.7	=	715.44	(78)
South	0.9x	0.77	x	15.74	x	114.87	x	0.85	x	0.7	=	745.53	(78)
South	0.9x	0.77	x	15.74	x	110.55	x	0.85	x	0.7	=	717.47	(78)
South	0.9x	0.77	x	15.74	x	108.01	x	0.85	x	0.7	=	701.01	(78)
South	0.9x	0.77	x	15.74	x	104.89	x	0.85	x	0.7	=	680.78	(78)
South	0.9x	0.77	x	15.74	x	101.89	x	0.85	x	0.7	=	661.25	(78)
South	0.9x	0.77	x	15.74	x	82.59	x	0.85	x	0.7	=	535.99	(78)
South	0.9x	0.77	x	15.74	x	55.42	x	0.85	x	0.7	=	359.67	(78)
South	0.9x	0.77	x	15.74	x	40.4	x	0.85	x	0.7	=	262.19	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=

375.93	633.09	846.58	1015.43	1106.34	1084.58	1051.39	985.74	905.44	694.44	448.96	322.56
--------	--------	--------	---------	---------	---------	---------	--------	--------	--------	--------	--------

 (83)

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

(84)m=

765.3	1020.46	1221.07	1369.16	1439.02	1396.91	1350.45	1290.58	1220.9	1030.87	809.51	701.16
-------	---------	---------	---------	---------	---------	---------	---------	--------	---------	--------	--------

 (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)

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.97	0.94	0.89	0.81	0.68	0.54	0.58	0.76	0.92	0.98	0.99

 (86)

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

(87)m=

18.46	18.82	19.3	19.89	20.38	20.75	20.91	20.89	20.62	19.95	19.1	18.43
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (87)

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

(88)m=

18.92	18.93	18.94	18.98	18.98	19.02	19.02	19.02	19	18.98	18.97	18.95
-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------

 (88)

DER WorkSheet: New dwelling created by change of use

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

(89)m=	0.98	0.96	0.92	0.85	0.73	0.53	0.33	0.37	0.63	0.87	0.96	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	15.79	16.31	17	17.83	18.47	18.89	19	18.99	18.77	17.95	16.75	15.76	(90)
--------	-------	-------	----	-------	-------	-------	----	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.51 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	17.14	17.58	18.16	18.87	19.43	19.83	19.96	19.95	19.71	18.96	17.94	17.11	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	17.14	17.58	18.16	18.87	19.43	19.83	19.96	19.95	19.71	18.96	17.94	17.11	(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	0.91	0.85	0.75	0.6	0.44	0.47	0.69	0.87	0.96	0.98	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	745.52	968.1	1111.72	1159.63	1078.33	838.38	591.03	611.92	837.65	900.54	773.88	686.59	(95)
--------	--------	-------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

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

(97)m=	2574.68	2528.85	2314.12	1928.13	1487.86	982.77	631.92	664.4	1063.62	1608.05	2106.34	2533.87	(97)
--------	---------	---------	---------	---------	---------	--------	--------	-------	---------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	1360.89	1048.82	894.58	553.32	304.69	0	0	0	0	526.38	959.37	1374.38	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												7022.44	(98)

Space heating requirement in kWh/m²/year

93.63	(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

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

100	(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)

1360.89	1048.82	894.58	553.32	304.69	0	0	0	0	526.38	959.37	1374.38
---------	---------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

1360.89	1048.82	894.58	553.32	304.69	0	0	0	0	526.38	959.37	1374.38
---------	---------	--------	--------	--------	---	---	---	---	--------	--------	---------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} = 7022.44 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

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

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

DER WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

100 (216)

(217)m= 100 100 100 100 100 100 100 100 100 100 100 100 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	182.47	160.6	168.12	149.95	146.39	130.02	124.11	137.23	137.31	155.52	165.41	177.83
---------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 1834.96 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

7022.44

Water heating fuel used

1834.96

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 0 (231)

Electricity for lighting

328.54 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

9185.94 (338)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	3644.64	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	952.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4596.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	170.51	(268)
Total CO2, kg/year			sum of (265)...(271) =	4767.5	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	63.57	(273)
EI rating (section 14)				48	(274)