
Brunswick Living Ltd

Environmental Standards Statement

Brunswick Street, Manchester

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Daniel Watt

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Watt Energy & Consulting Engineers Ltd

40 King Street, Manchester, M2 6BA

t. 0161 43 43 103

w. www.wece.co.uk



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Director

Daniel Watt



Energy and Sustainability Consultant

Jack Sewell

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1. Executive Summary

This Environmental Standards Statement has been prepared by Watt Energy on behalf of Brunswick Living Ltd to support a planning application for the development of Brunswick Street. 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):

- Guide to Development in Manchester SPD (1007)
- Our Manchester Strategy 2016-2025
- Manchester: A Certain Future (2013)
- Manchester Climate Change Board – The Zero Carbon Framework 2020-2038
- Climate Change and Low Emissions Implementation Plan 2016-2020
- Meeting Our Objectives and Targets – Manchester Climate Change Framework – 2020-25
- Manchester Residential Quality Guidance
- Core Strategy Policy DM 1 - Development Management
- Core Strategy Policy EN 4 - Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development
- Core Strategy Policy EN 6 - Target Framework for CO₂ Reductions from Low or Zero Carbon Energy Supplies
- Core Strategy Policy EN 8 – Adaptation to Climate Change
- Core Strategy Policy EN 9 – Green Infrastructure
- Core Strategy Policy EN 14 – Flood Risk
- Core Strategy Policy EN 15 – Biodiversity and Geological Conservation
- Core Strategy Policy T 1 – Sustainable Transport

The statement details how the development will incorporate sustainable design and resource efficiency in line with the Energy Hierarchy, 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 **9%** reduction in carbon emissions over Part L 2013 of the Building Regulations and also aim for a status of **Carbon Neutral**.

In order to achieve compliance, the development has been designed with a holistic low energy design concept involving a fabric first approach. The U-values, design air permeability and ventilation targets all aspire to Passive House design standards along with the consideration and application of low zero carbon renewable technologies.

Following the LZC feasibility assessment, the currently proposed strategy for the the development will include a site wide **2.80kWp PV array**.



As a result of the above the predicted site wide reduction in CO₂ over Part L 2013 of the Building Regulations can be summarised as

- **9.3%** with SAP 9 carbon factors
- **32.8%** with SAP 10.0 carbon factors
- **59.3%** with SAP 10.1 carbon factors

The above figures include a renewable energy contribution of **5.4%**. These are in addition to the total on-site energy being provided by a 100% renewable energy electricity provider therefore classifying the development as both **Low Carbon** and **Carbon Neutral**.

The figures and array sizes mentioned are all based on the currently proposed strategy and is therefore liable to change. However, it will be ensured that any alterations to this strategy will remain compliant with all Manchester City Council's current and future planning policies.

This statement also examines how the design, specification and characteristics of the proposal will contribute to sustainability and meet the relevant objectives outlined within the National Planning Policy Framework (NPPF) 2019, in addition to the Manchester Council approved climate change action plans and core strategy planning policies outlined above. The sustainability measures assessed included:

- Flood Risk Zone
- Green and Blue Infrastructure
- Sustainable Drainage Systems (SUDs)
- Biodiversity / Ecology
- Internal Water Efficiency
- Waste Management
- Materials
- Health and Wellbeing
- Sustainable Transport

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



2. Planning Statement

The following statement relates to the proposed development at Brunswick Street, Ardwick, Manchester, M13.

2.1 The Development

The development being applied for is the erection of a residential development comprising 1 no. apartment block reaching 6 storeys, to form 16 residential single storey apartments (Use Class C3). These are in addition to associated residential amenity areas; including a residential lounge, refuse storage, plant (including substation), car parking and cycle storage.



Fig 1: Site Plan (not to scale)

Table 1 below sets out a schedule of the accommodation.

Area Use	Quantum
Residential Units (Use Class C3)	1 Bed Apartments: 5
	2 Bed Apartments: 11
	Total: 16

Table 1: Schedule of Accommodation

2.2 Relevant Policies and Guidance

2.2.1 Local Planning Policy

2.2.1.1 Manchester Core Strategy

Manchester's Core Strategy (CS) was adopted on 11th July 2012 and is the key Development Plan Document (DPD) guiding the measures assessed in this report.

CS Policy DM 1 - Development Management: Stipulates that all new development should have regard for several development principles relevant to sustainability, including: waste management, designing for health, flood risk, green infrastructure, biodiversity. Additionally, subject to scheme viability, developers will be required to demonstrate that new non-domestic development will achieve a BREEAM Rating of 'Very Good' or for domestic development to achieve the Code for Sustainable Homes standard.

CS Policy EN 4 – Reducing CO2 Emissions: This policy targets the reducing of CO2 emissions through the following of the energy hierarchy; firstly reducing the need for energy through efficient design measures, followed by clean energy and lastly, the application of renewable or LZC technologies. In addition to this point, MCC state within this policy all new development is required to use building materials that have low embodied carbon.

CS Policy EN 6 - Target Framework for CO2 Reductions from Low or Zero Carbon Energy Supplies: This Policy requires electricity intense residential development of 10 or more units to meet, as a minimum, a 15% reduction in domestic CO2 emissions over Part L of the 2010 Building Regulations, unless proven to be unviable. As Part L 2013 of the Building Regulations represents a 6% improvement on 2010 levels, this target is subsequently equivalent to a 9% improvement in CO2 emissions over Part L 2013. Section 2.3 provides evidence of how this target is achieved.

CS Policy EN 8 – Adaptation to Climate Change: Expects all new development to be adaptable to climate change in terms of its design, layout, siting, and function of both building associated external spaces.

CS Policy EN 9 – Green Infrastructure: Requires new developments to maintain existing green infrastructure whilst using every opportunity, in accordance with current Green Infrastructure Strategies, to enhance the quality and quantity of green infrastructure, improve the performance of its functions and create and improve linkages to and between area of green infrastructure.

CS Policy EN 14 – Flood Risk: This policy expects all new developments to minimise surface water run-off through the use of SUDs and Green Infrastructure.

CS Policy EN 15 – Biodiversity and Geological Enhancement: Developers will be expected to identify and implement reasonable opportunities to enhance, restore or create new biodiversity, either on or adjacent to the proposed site.

CS Policy T 1 – Sustainable Transport: Policy aims to deliver sustainable, high quality, integrated transport systems to encourage a shift away from car travel to public transport, cycling and walking.



2.2.1.2 Guide to Development in Manchester., Supplementary Planning Document

The Development Guide in Manchester Supplementary Planning Documents (SPD) establish and set out the ongoing generation of the City by providing a set of set principles which will guide developers, architects, and residents in the design of the city. The MCC Core Strategy stipulates that all new residential developments should comply with the design guidance set out in the SPDs. These principles include the following environmental standards relevant to this report: energy strategy, water consumption, drainage management, weather resilience, waste management, construction management, biodiversity, and waterways.

2.2.1.3 Manchester Residential Quality Guide

The Manchester Residential Quality Guide has been developed to help shape the creation of new homes and communities across the Greater Manchester city region, beginning with the Centre and its immediate surroundings. This document outlines the considerations, qualities, and opportunities that will help to deliver high quality residential development as part of successful and sustainable neighbourhoods across Manchester. The guidance includes the following nine components:

Make it Manchester – developers must understand the city’s unique character, heritage old and new, density and scale in various parts of the city and appreciate how new homes will fit in to what’s already there.

Make it bring people together – new homes must encourage a sense of community and neighborliness, offering a mix of tenures to promote a mix of people.

Make it animate streets and spaces – understand the relationship between new homes and its environment and create public space.

Make it easy to get around – make sure developments have good transport links, along with good walking and cycling provision.

Make work with the landscape – development should improve the connection with the local environment with improved biodiversity, as well as greening and water schemes.

Make it practical – dealing with waste, car parking, bike storage and visitors should be made as easy as possible.

Make it future proof – design must anticipate the impacts of climate change and extreme weather with efficient design and adaptability.

Make it a home – sufficient space, natural light, privacy and storage are essential for people to settle down and flourish.

Make it happen – ensuring proposals are delivered, to a high quality, with high design standards and high sustainability.



2.2.1.4 Manchester's Great Outdoors

A Green and Blue Infrastructure Strategy for Manchester aims to invest to date in the city's Green and Blue infrastructure over the next 10 years (by 2025). Four objectives have been established to enable the vision to be achieved: 1. Improve the quality and function of existing green and blue Infrastructure, to maximize the benefits it delivers. 2. Use appropriate green and blue infrastructure as a key component of new developments to help create successful neighborhoods and support the city's growth. 3. Improve connectivity and accessibility to green and blue infrastructure within the city and beyond. 4. Improve and promote a wider understanding and awareness of the benefits that green and blue infrastructure provides to residents, the economy, and the local environment.

2.2.1.5 Manchester Climate Change Framework 2020-25

Following the declaration of a climate emergency by MCC In July 2019, this framework was adopted and is an in-depth strategy to accompany the Draft Manchester Zero Carbon Framework 2020-38, which was published in February 2019. It is a framework that will continue to develop over the next five years, in line with changes in policy, climate science, rate of progress and other factors. The framework has set out four objectives to facilitate this:

Objective 1 – Staying within our carbon budgets.

- Direct CO2 emissions: staying within our 15-million-ton carbon budget for 2018-2100, including reducing the CO2 emitted from our homes, workplaces and ground transport by at least 50% during 2020-25.
- Indirect CO2 emissions: understanding and taking action on the things that we consume, and which generate greenhouse gases through their production, transportation and disposal.

Objective 2 – Climate adaptation and resilience

- Increase the amount of urban green infrastructure cover, aiming for a 10% increase by 2038 from 2018 levels, in line with the Greater Manchester aim.
- Respond to these risks by incorporating adaptation and resilience within our plans and strategies, and acting to make necessary changes to our buildings, infrastructure and our natural environment.

Objective 3 – Health and wellbeing

- Adapt the city's built and natural environment and prepare our residents to become more resilient to these changes. Increasing the amount and quality of green space to enable residents to benefit from the improved physical and mental health that will come as a result.
- Improving the energy efficiency of the city's homes and providing access to affordable, secure supplies of renewable energy are essential help get 38,000 Manchester households out of fuel poverty.



Objective 4 – Inclusive, zero carbon and climate resilient economy

- Ensure that Manchester establishes an inclusive, zero carbon and climate resilient economy where everyone can benefit from playing an active role in decarbonising and adapting the city to the changing climate.



2.2.2 Sustainable Design Definitions

As a result of ever changing and improving carbon emission targets, developments are required to take more sustainable approaches to the construction of their buildings which commonly differ from site to site. This results in buildings being explained under many definitions and using various terminology when they incorporate sustainable design to reduce these carbon emissions.

The most common of these terminologies can be summarised as:

- Net Zero Carbon
- Carbon Neutral
- Low Carbon

The below table outlines the formal definitions of each of these terminologies.

Terminology:	Carbon / Energy targets:	Definition:
Net Zero Carbon	Net Zero carbon emissions	Buildings that generate 100% of their energy needs on-site without the need to import energy.
Carbon Neutral	Net Zero carbon emissions	Buildings achieving net zero carbon emissions by offsetting through the use of a renewable energy supplier (electricity only) or via a financial contribution.
Low Carbon	Carbon emission % reduction normally over the building regulation standards.	Buildings achieving reduced carbon emission through energy-efficient design .

Table 2: Overview of Sustainable Design Definitions



2.2.3 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:	Low Carbon Target:	Sustainable Design Definition:
Manchester Council's Core Strategy 2012-2027	Adopted 2012	Targets a 9% reduction in carbon emissions over Part L Building Regulations.	Low Carbon (9% over Part L 2013)
Climate Change and Low Emission Strategies 2016-2020	Adopted 2016	Targets a 48% reduction in carbon emissions from 1990 - 2020	Low Carbon (48% over 1990 emissions)
Manchester: A Certain Future	Produced in 2009, updated in 2013	Targets emitting 41% less CO ₂ in 2020 than in 2005 – Equates to 9% over Part L 2013 (if going by Part L requirements)	Low Carbon (9% over Part L 2013)
Draft Manchester Zero Carbon Framework	February 2019	Targets reducing carbon emissions by 50% over 2018 levels by 2022 and zero carbon by 2038	Low Carbon (50% over Part L 2013) by 2022, and Carbon Neutral by 2038

Table 3: Overview of Manchester Planning Documents Carbon Targets



2.2.4 National Planning Policy

The NPPF (February 2019) sets out the Government's planning policies for England and how these are expected to be applied. The overall emphasis of the NPPF is to reiterate the Government's key objectives, including securing sustainable development.

The NPPF defines the purpose of the planning system as being to contribute to the achievement of sustainable development. It explains at Paragraph 8 that there are three dimensions to sustainable development. These are economic, social, and environmental and should be pursued simultaneously through the planning system.

Paragraph 10 states that at the heart of the Framework is a presumption in favour of sustainable development.



2.3 Sustainable Design Strategy

2.3.1 Energy and Carbon Emissions

Building Services Strategy

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 9% 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.
2. Assist in achieving carbon neutrality by 2038.

To achieve the most accurate calculations and estimates, the proposed units have been modelled using SAP 2012 the governments Standard Assessment Procedure for residential dwellings.

The proposed strategy for minimising energy use and carbon emissions is based on the energy hierarchy described in CIBSE Guide F 2012 (Energy efficiency in buildings). The energy hierarchy has been adopted for the development to ensure that the correct approach to design is taken to promote an energy-efficient low carbon solution (see figure 2). This has ensured that the benefits of effective methods of energy use reduction have been maximised first. The approach adopted is as follows:



Fig 2: Energy Hierarchy

Minimise energy demand – Implement passive design measures and optimise the building envelope in terms of orientation, air tightness, and insulation. For example, the proposal is targeting a low carbon classification through a holistic low energy design concept as it will be designed with a fabric first approach whereby Passive House design standards are aspired to for all fabric U-values and air permeability targets.

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting and system controls to facilitate efficient operation. For example, the currently proposed design has utilised Mechanical Ventilation Heat Recovery (MVHR) systems with high efficiencies to recover heat from all exhaust air.

Particular attention is being paid to the wellbeing of occupants. The ventilation strategy has been developed to minimise noise ingress from the proposed location as far as possible while minimising the risk of overheating.

Additional Renewable Energy Measures

Opportunities for incorporating low and zero carbon technologies (LZCT) have been considered for this development. The viability of several separate technologies was examined in a LZCT study (see section 3) which helped to identify potential opportunities for the inclusion of PV panels

Based on the current design strategy, roof-mounted PV panels are to be provided. They will be located on suitable roof-top areas of the apartment blocks and contribute significantly to the emissions performance of the development.

In addition, 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.

- Aspiring Passive House design standards
- High levels of insulation throughout with minimal thermal bridges
- Passive solar gains and internal heat sources
- Excellent level of airtightness
- Good indoor air quality by openable windows
- 100% operational energy supplied by a renewable energy provider

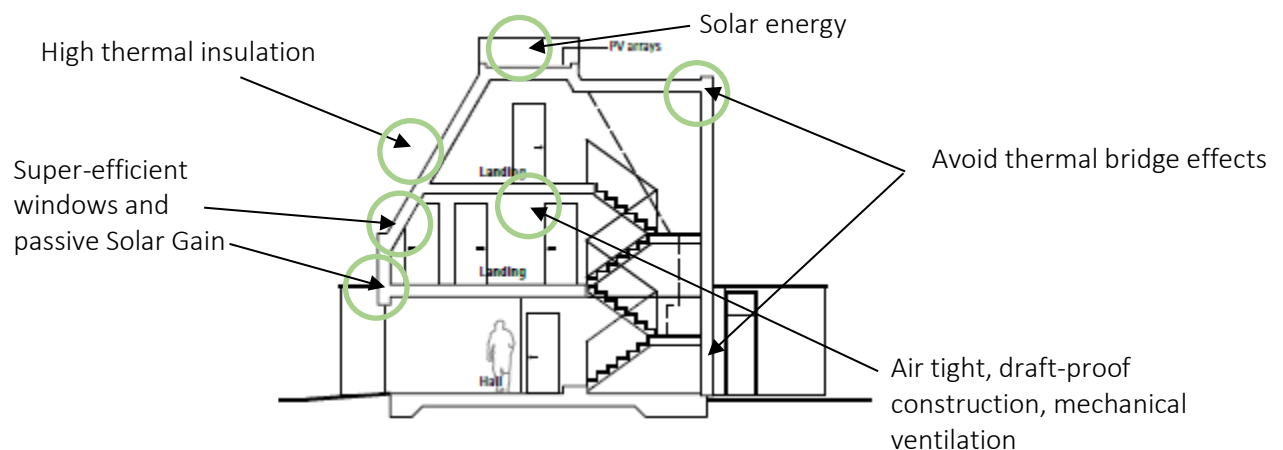


Fig 3. Efficient Design Measure examples

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

Residential Units:

- Ground/Exposed Floor U-values of $0.15 \text{ W/m}^2\text{K}$
- External Wall U-values of $0.20 \text{ W/m}^2\text{K}$
- Roof (all types) U-values of $0.10 \text{ W/m}^2\text{K}$
- Use of ACD's to minimize Thermal Bridging and ψ Value with the integration of hi-therm lintels that have a ψ value of 0.03
- Low Window U-values of $1.4 \text{ W/m}^2\text{K}$
- 100% low energy lighting throughout
- 100% efficient non-fossil fuel Electric Heating
- Electric Hot Water Cylinders (120L/150L) – Oso Super Xpress cylinders assumed in calculations
- Air Permeability Rate of $3\text{m}^3/\text{hm}^2$ in all dwellings
- MVHR Ventilation to each dwelling – Vent Axia Sentinel Kinetic FH assumed in calculations

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, based on the current design strategy, it is proposed that the development will feature the following Low/Zero carbon Technologies:

- **2.80kWp Site Wide PV Array (Approx. 9no. 310W Panels) implemented onto the roof of the apartment block**

The above LZC contribution has provided a **5.4%** reduction in CO₂ following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **2418.1 kWh/Yr**
- CO₂ Saving from onsite LZC Technologies = **1255.0 kgCO₂/Yr**

The above PV allocation is based on the currently proposed design strategy, however this could change throughout the course of the project and as a result the figures outlined above may also change or be omitted completely.



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)		
Carbon Factors	SAP 9.0	SAP 10.0	SAP 10.1
Baseline emissions	24199.8	14670.4	14137.2
Improved emissions (after application of energy efficiency measures)	23202.7	10416.6	6080.1
Improved emissions (after incorporation of efficient energy supply)	23202.7	10416.6	6080.1
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	21947.8	9853.2	5751.2
% CO ₂ displaced in total	9.3%	32.8%	59.3%
% CO ₂ displaced by energy efficiency measures	4.1%	29.0%	57.0%
% CO ₂ displaced by efficient supply of energy	0.0%	0.0%	0.0%
% CO ₂ displaced by LZC Technologies	5.4%	5.4%	5.4%

Table 4: 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)	69257.1		24199.8	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	44706.6	35.4%	23202.7	4.1%
Proposed scheme after on-site renewables	42288.6	38.9%	21947.8	5.4%
Proposed scheme offset for financial contribution or other "allowable solution"			0	0
Total savings on residual emissions				9.3%

Table 5. Total Energy and Carbon Emissions Savings Based on SAP 9.0 Carbon Factors



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)	69257.1
Regulated emissions (kg pa)	24199.8

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)	24199.8

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)	24550.4
Emission savings from energy efficiency measures (kg pa)	997.0
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	23202.7

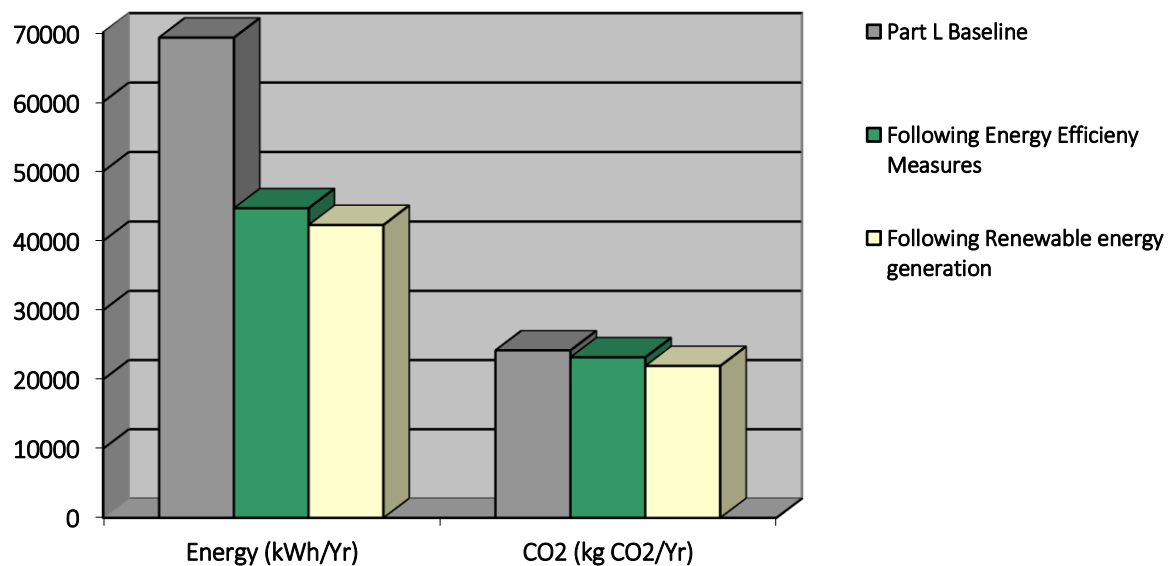


On-site renewables

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)	2418.1
Saving on residual emissions from the use of renewables (kg)	1255.0
Saving on residual emissions from the use of renewables (%)	5.4%

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 currently proposed 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 9.3% reduction in carbon emissions over Part L 2013 - exceeding the EN6 documents Low Carbon target of 9% over Part L 2013.
Climate Change and Low Emission Strategies 2016-2020	The Sustainable Design Strategy achieves a 9.3% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 48% over 1990 Emissions.
Manchester: A Certain Future	The Sustainable Design Strategy achieves a 9.3% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 9% over Part L 2013.
Draft Manchester Zero Carbon Framework	Design Strategy fully adheres with the Carbon Neutral definition through the offsetting of operational emissions by procuring the total electricity supply from a 100% renewable energy provider.

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 16 apartments at Brunswick Street achieves a total reduction of **9.3%** in carbon emissions over Part L 2013 whilst supplying 100% of the operational energy from a renewable energy supplier. This therefore allows the development to be regarded as both low carbon and carbon neutral, with regards to its carbon emissions. As previously mentioned, this is the currently proposed strategy and may change throughout the project, however compliancy will still be achieved.

The low carbon classification for Brunswick Street can be derived from its prioritisation of fabric first approach and the specifying of multiple low carbon technologies to further reduce the operational emissions.

The site can be defined as **Carbon Neutral** because 100% of the carbon emissions produced on-site will be offset by having all the energy supplied by a renewable energy electricity provider.

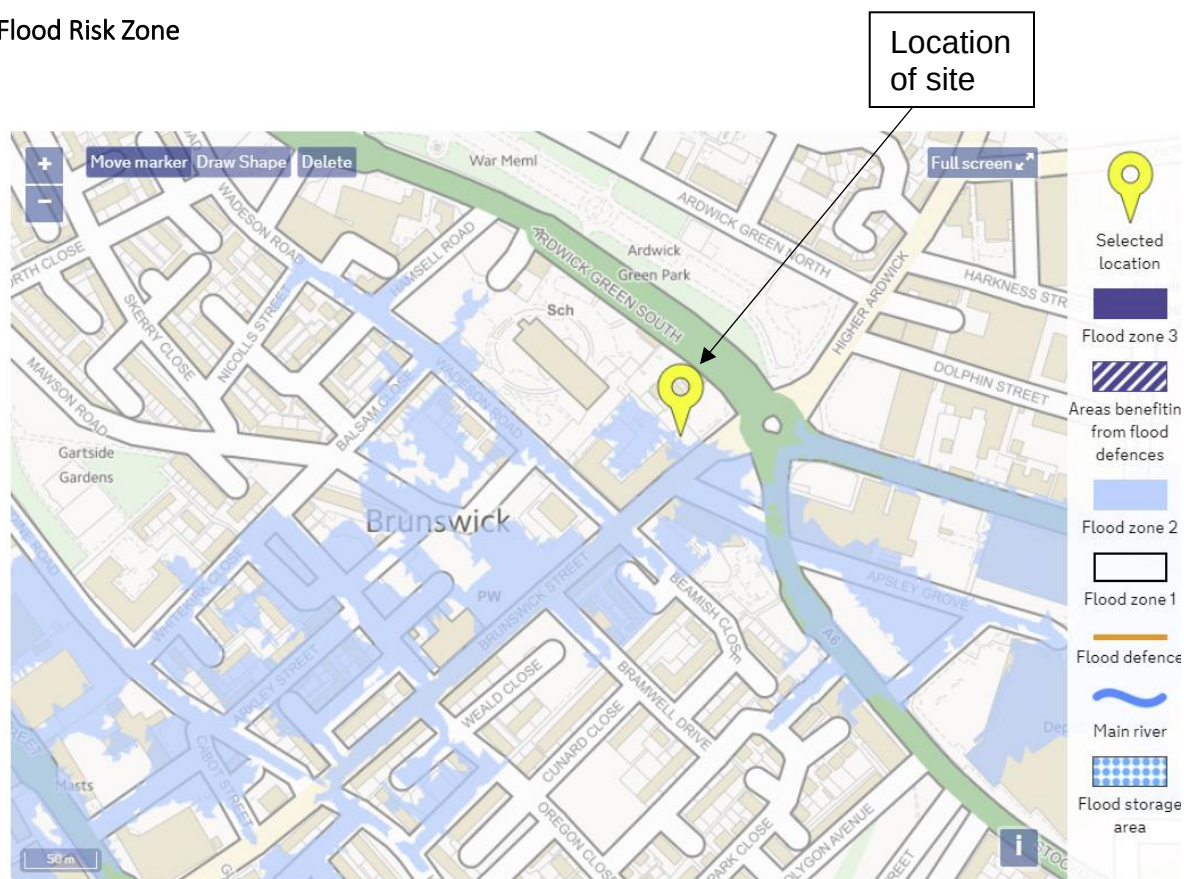


2.4 Adaptation to Climate Change

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 be seen that the site is located on the border between flood risk zone 1 and flood risk zone 2 and therefore potentially has a medium 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)

As it has been determined that the proposed development is situated on the border between flood risk zones 1 and 2, it will be required that a flood risk assessment is carried out by a suitable qualified professional. This assessment will determine an accurate flood risk for the site and also outline any potential implications in the increase of impermeable surfaces as a result of the proposal. Finally, this assessment will propose SUDs measures that will need to be incorporated into the design that will alleviate the flood risk of the site.

Biodiversity

As a result of the nature of the proposal: including the potential change in area of impermeable surface, there could be adverse impacts on the surrounding ecology as well potential for the enhancement. Therefore, an ecology report should be produced, by a suitably qualified professional, in order to ensure that any existing ecology on or near the site is adequately protected and to determine the possibility of biodiversity enhancement through new habitat creation, planting schemes and green wall areas.



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 each floor will have a small bin store in addition to a number of large waste and recycling bins located within the bin store at ground floor level.

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 site, 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 full daylight and sunlight analysis assessment should be carried out for the proposed development to ensure that compliant levels of vertical sky component (VSC), no sky line (NSL) and annual probabal sunlight hours (APSH) are achieved.

In addition to having this assessment completed, the following measures will also be incorporated:

- Efficient MVHR Units are to be specified to each individual dwelling which will provide a continuous source of fresh, filtered air to maintain a healthy indoor environment.
- Secure by Design accreditation will be sought which will incorporate the adoption of crime prevention measures to further prevent crime and promote a safe environment.

The above findings and technology will all help to promote healthy housing for residents which has been identified by the World Health Organisation (WHO) as an increasingly important factor in increasing quality of life, preventing disease and illness, and mitigating climate change.

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 to the ground floor 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 15 minute walk to Manchester Piccadilly train, 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.



3. 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. The amount proposed at this stage is **2.80kWp Site Wide PV Array (Approx. 9no. 310W Panels)** implemented onto the main roof area of the apartment block.

Chosen Renewable Technology



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



4. Conclusion

This statement has assessed the proposed development at the Brunswick Street 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. In addition, the proposal has been assessed against national sustainable design definitions to determine how it can be classified.

As part of this process, the development was designed with a fabric first approach; with U-values, design air permeability and ventilation targets all aspiring to Passive House design standards and therefore significantly exceeding Building Regulations Part L 2013 standards. Following on from this, efficient MVHR systems were proposed for each apartment, to further reduce the total energy demands whilst simultaneously providing each dwelling with healthy internal environments. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus led to high-energy performance targets and being defined as a low carbon development.

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 based on the current design strategy, which is yet to be completely finalised and therefore the following array and figures could change, a 2.80 kWp system can be proposed at this stage, which would equate to 9No panels and would provide an additional 5.4% reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to **9.3%**, when using SAP 9.0 carbon factors. However, this reduction rises further to **32.8%** and **59.3%** when using SAP 10 and 10.1 carbon factors. In addition to this renewable technology provision, the development can also be defined as carbon neutral because it will have net zero carbon emissions. This is to be achieved by obtaining all the energy used on site from a 100% renewable energy electricity supply provider.

The development will also be adapting to climate change by incorporating sustainable drainage measures into the design, protecting existing ecology, enhancing biodiversity where possible, providing cycle storage provision to all apartments.

In addition to the following of the energy hierarchy through the efficient design and renewable technology measures mentioned, and meeting all relevant Manchester City Council carbon targets the proposal will include a large number of sustainability measures throughout construction and once completed, which will contribute heavily to the development's sustainability performance and accord with the requirements of the NPPF. The key measures to be included and therefore can be taken from this report include:

- A SUDs strategy will be produced to outline all measures to be incorporated that will ensure any additional surface water is collected, treated and removed.
- The development will incorporate green infrastructure wherever possible to enhance biodiversity whilst protecting existing ecology.



- Internal water efficiency will be prioritised by ensuring that efficient water fixtures are proposed so that each dwelling achieves less than 110L per person per day and 'A' rated appliances will be specified where possible.
- Waste minimisation will be targeted from throughout construction and occupational phase. It is targeted that at least 90% of construction waste will be diverted from landfill. Whilst tri-separator refuse shoots will be installed on each floor to promote recycling.
- In addition to targeting Secure by Design accreditation through adoption crime prevention measures, the site layout promotes busy spaces and routes and facilitates natural surveillance. These will therefore reduce the fear of crime and subsequently improving mental health of residents, visitors and workers.
- Prioritising reusing existing materials and locally sourced materials for construction to reduce waste and transportation to landfill in addition and promote a low embodied carbon development.
- When new materials are specified that are not locally attainable then only those that score well on the BRE: The Green Guide to Specification are to be used; to further encourage the use of sustainable materials and reductions in embodied carbon.
- Highly efficient MVHR systems are being proposed to each flat individually to provide a continuous source of fresh air and maintain healthy indoor environments. These will promote healthy housing and subsequently boost physical and mental wellbeing of residents.
- The proximity of the Manchester City Centre to the proposed site is highly sustainable in terms of transport and local amenities as it is in close proximity to a number of public transport nodes including: Manchester Piccadilly train station and bus stops, as well as a multitude of shops and other local amenities.
- The development will also include significant cycle storage provision.

As a result of all the above, the proposed sustainable design and energy 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 – Brunswick Street, Ardwick, Manchester, M13

House Type	Flat 1	Flat 2	Flat 3	Flat 4	Flat 5	Flat 6
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	3651.81	1859.51	1458.93	1980.19	1573.14	1147.24
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0
Water Fuel Requirement (DER)	2389.89	2202.86	2040.03	2199.6	2211.49	2051.25
Electricity Pumps Fans Requirement (DER)	75	75	75	75	75	75
Electricity Lighting Requirement (DER)	354.85	276.25	235.9	276.25	276.25	235.9
TOTAL PER DEVELOPMENT						
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	2486.63	1040.69	770.69	1148.68	775.6	510.09
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0
Water Fuel Requirement (DER)	1719.66	1536.58	1390.91	1536.58	1536.58	1390.91
Electricity Pumps Fans Requirement (DER)	180.07	133.96	98.93	133.96	133.96	98.93
Electricity Lighting Requirement (DER)	354.85	276.25	235.9	276.25	276.25	235.9
TOTAL PER DEVELOPMENT						
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	2486.63	1040.69	770.69	1148.68	775.6	510.09
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0
Water Fuel Requirement (DER)	1719.66	1536.58	1390.91	1536.58	1536.58	1390.91
Electricity Pumps Fans Requirement (DER)	180.07	133.96	98.93	133.96	133.96	98.93
Electricity Lighting Requirement (DER)	354.85	276.25	235.9	276.25	276.25	235.9
PV Energy Produced (DER)	-151.1	-151.1	-151.1	-151.1	-151.1	-151.1
TOTAL PER DEVELOPMENT						



Appendix A – Energy Demand Assessment – Brunswick Street, Ardwick, Manchester, M13

Flat 7	Flat 8	Flat 9	Flat 10	Flat 11	Flat 12	Flat 13	Flat 14
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)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
1584.67	1573.14	1147.24	1584.67	1573.14	1147.24	1584.67	2570.51
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
2211.14	2211.49	2051.25	2211.14	2211.49	2051.25	2211.14	2185.97
75	75	75	75	75	75	75	75
276.25	276.25	235.9	276.25	276.25	235.9	276.25	276.25
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)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
784.01	775.6	510.09	784.01	775.6	510.09	784.01	1014.19
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
1536.58	1536.58	1390.91	1536.58	1536.58	1390.91	1536.58	1536.58
133.96	133.96	98.93	133.96	133.96	98.93	133.96	133.96
276.25	276.25	235.9	276.25	276.25	235.9	276.25	276.25
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)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)
784.01	775.6	510.09	784.01	775.6	510.09	784.01	1014.19
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
1536.58	1536.58	1390.91	1536.58	1536.58	1390.91	1536.58	1536.58
133.96	133.96	98.93	133.96	133.96	98.93	133.96	133.96
276.25	276.25	235.9	276.25	276.25	235.9	276.25	276.25
-151.1	-151.1	-151.1	-151.1	-151.1	-151.1	-151.1	-151.1



Appendix A – Energy Demand Assessment – Brunswick Street, Ardwick, Manchester, M13

Flat 15	Flat 16	TOTAL (kWh/yr)	SAP 9.0	TOTAL (kgCO2/yr)	SAP 10.0	TOTAL (kgCO2/yr)	SAP 10.1	TOTAL (kgCO2/yr)
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
2084.73	2591.02	29111.9	0.216	9746.6	0.210	6113.5	0.210	6113.5
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.216	0.0	0.233	0.0	0.136	0.0
2022.78	2185.58	34648.4	0.216	11600.3	0.210	7276.2	0.210	7276.2
75	75	1200.0	0.519	622.8	0.233	279.6	0.136	163.2
235.9	276.25	4296.9	0.519	2230.1	0.233	1001.2	0.136	584.4
		69257.1		24199.8		14670.4		14137.2
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
662.66	1022.82	14355.5	0.519	7450.5	0.233	3344.8	0.136	1952.3
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
1390.91	1536.58	24040.0	0.519	12476.8	0.233	5601.3	0.136	3269.4
98.93	133.96	2014.3	0.519	1045.4	0.233	469.3	0.136	273.9
235.9	276.25	4296.9	0.519	2230.1	0.233	1001.2	0.136	584.4
		44706.6		23202.7		10416.6		6080.1
Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
662.66	1022.82	14355.5	0.519	7450.5	0.233	3344.8	0.136	1952.3
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
1390.91	1536.58	24040.0	0.519	12476.8	0.233	5601.3	0.136	3269.4
98.93	133.96	2014.3	0.519	1045.4	0.233	469.3	0.136	273.9
235.9	276.25	4296.9	0.519	2230.1	0.233	1001.2	0.136	584.4
-151.1	-151.1	-2418.1	0.519	-1255.0	0.233	-563.4	0.136	-328.9
		42288.6		21947.8		9853.2		5751.2



Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 01 July 2021 at 17:59:57

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 61m²

Site Reference : Brunswick Street

Plot Reference: Apartment 02

Address : Apartment 02, Brunswick Street, Manchester, M13 9TQ

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 25.28 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 24.13 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.7 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 35.3 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals 3.00 (design value)
Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system: Room heaters - electric
Panel, convector or radiant heaters

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: Measured cylinder loss: 1.13 kWh/day
Permitted by DBSCG: 1.89 kWh/day **OK**
Primary pipework insulated: No primary pipework

6 Controls

Space heating controls: Programmer and appliance thermostats **OK**
Hot water controls: Cylinderstat **OK**

Regulations Compliance Report

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.6	
Maximum	1.5	OK
MVHR efficiency:	88%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (North West England):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: West	5.04m ²	
Windows facing: West	2.6m ²	
Windows facing: North	5.52m ²	
Windows facing: North	0.77m ²	
Windows facing: South	0.77m ²	
Ventilation rate:	3.00	

10 Key features

Air permeability	3.0 m ³ /m ² h
Photovoltaic array	

Predicted Energy Assessment



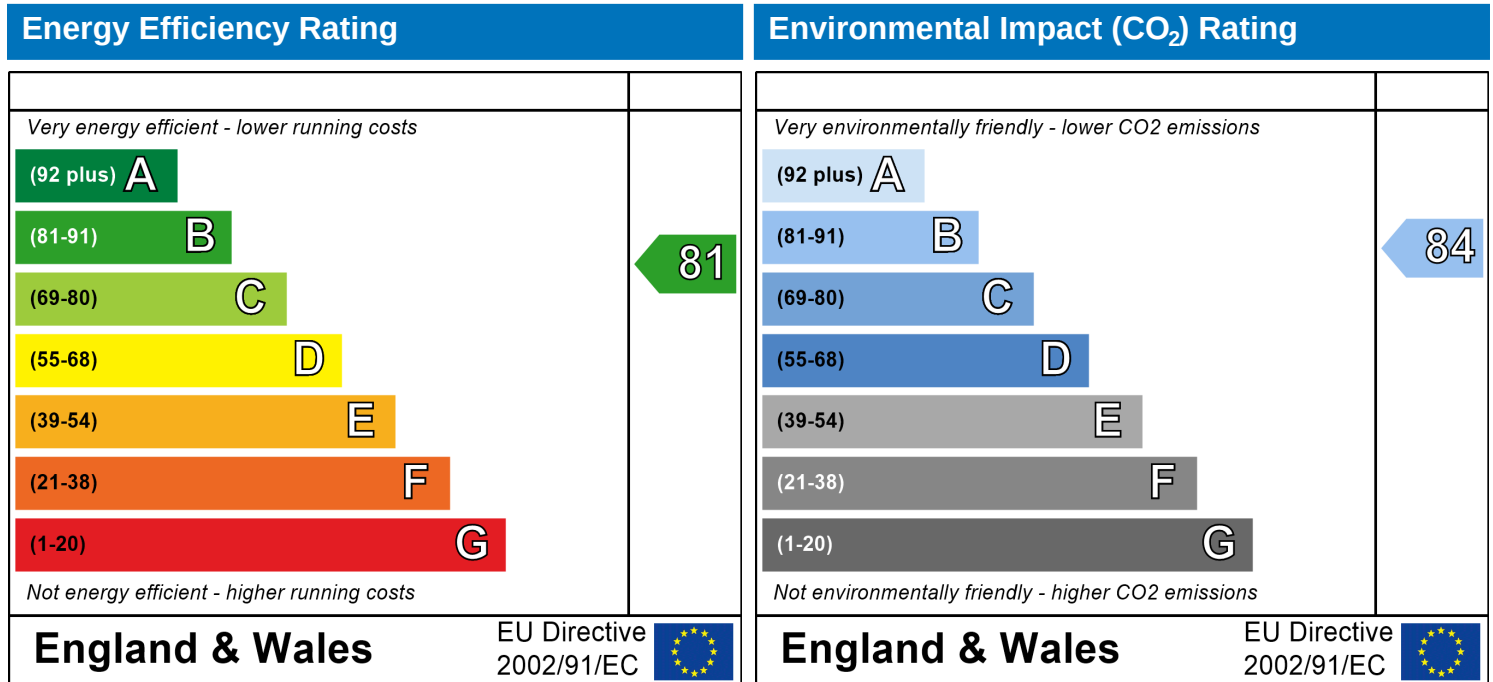
Apartment 02
Brunswick Street
Manchester
M13 9TQ

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

Mid floor Flat
06 April 2021
Daniel Watt
61 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: Apartment 02

Address: Apartment 02, Brunswick Street, Manchester, M13 9TQ
Located in: England
Region: North West England
UPRN:
Date of assessment: 06 April 2021
Date of certificate: 01 July 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 479

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2021
Floor Location: Floor area: Storey height:
 Floor 0 61 m² 2.4 m
Living area: 20.55 m² (fraction 0.337)
Front of dwelling faces: East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
West glazing (large)	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
West glazing (small)	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
North glazing (large)	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
North glazing (small)	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
South glazing	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
West glazing (large)	16mm or more	0.7	0.72	1.4	5.04	1
West glazing (small)	16mm or more	0.7	0.72	1.4	1.3	2
North glazing (large)	16mm or more	0.7	0.72	1.4	5.52	1
North glazing (small)	16mm or more	0.7	0.72	1.4	0.77	1
South glazing	16mm or more	0.7	0.72	1.4	0.77	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
West glazing (large)		External walls	West	3.88	1.3
West glazing (small)		External walls	West	1	1.3
North glazing (large)		External walls	North	2.51	2.2
North glazing (small)		External walls	North	0.59	1.3
South glazing		External walls	South	0.59	1.3

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External walls	45.456	14.7	30.76	0.2	0	False	N/A
Exposed floor	17.3			0.15			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

SAP Input

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.1192			
	Length	Psi-value		
	9.57	0.03	E2	Other lintels (including other steel lintels)
[Approved]	9.57	0.04	E3	Sill
[Approved]	19.2	0.05	E4	Jamb
[Approved]	33.67	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	2.4	0.09	E16	Corner (normal)
[Approved]	4.8	0.06	E18	Party wall between dwellings
	4.21	0.32	E20	Exposed floor (normal)
	4.11	0.16	P7	Exposed floor (normal)
	4.11	0.24	P8	Exposed floor (inverted)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery
	Number of wet rooms: Kitchen + 2
	Ductwork: Insulation, rigid
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

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

Main heating Control:

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

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: Measured loss, 1.13kWh/day
	Primary pipework insulation: False
	Cylinderstat: True
	Cylinder in heated space: True
	Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory

SAP Input

Low energy lights:	100%
Terrain type:	Dense urban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u> Installed Peak power: 0.175 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

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

Property Address: Apartment 02

Address : Apartment 02, Brunswick Street, Manchester, M13 9TQ

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61 (1a)	2.4 (2a)	146.4 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	146.4 (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				0	0 (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) =	0	÷ (5) =	0 (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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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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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SAP WorkSheet: New dwelling design stage

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

74.8 (23c)

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

(24a)m= 0.29 0.29 0.28 0.27 0.26 0.25 0.25 0.24 0.25 0.26 0.27 0.28 (24a)

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

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

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

if (22b)m < 0.5 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 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.29 0.29 0.28 0.27 0.26 0.25 0.25 0.24 0.25 0.26 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.04	$x1/[1/(1.4)+0.04] =$	6.68		(27)
Windows Type 2			1.3	$x1/[1/(1.4)+0.04] =$	1.72		(27)
Windows Type 3			5.52	$x1/[1/(1.4)+0.04] =$	7.32		(27)
Windows Type 4			0.77	$x1/[1/(1.4)+0.04] =$	1.02		(27)
Windows Type 5			0.77	$x1/[1/(1.4)+0.04] =$	1.02		(27)
Floor			17.3	x 0.15 =	2.595		(28)
Walls	45.46	14.7	30.76	x 0.2 =	6.15		(29)
Total area of elements, m²			62.76				(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) = 28.23 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 776.58 (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 7.48 (36)

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

Total fabric heat loss (33) + (36) = 35.72 (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=	13.94	13.79	13.63	12.86	12.71	11.94	11.94	11.79	12.25	12.71	13.02	13.33

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

(39)m= 49.66 49.5 49.35 48.58 48.43 47.66 47.66 47.5 47.96 48.43 48.73 49.04
Average = Sum(39)_{1...12} /12= 48.54 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.81	0.81	0.81	0.8	0.79	0.78	0.78	0.78	0.79	0.79	0.8	0.8		
	Average = Sum(40) _{1...12} /12=												0.8	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.01

(42)

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

if TFA ≤ 13.9, N = 1

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

81.93

(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 Vd,m = factor from Table 1c x (43)

(44)m=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13		
	Total = Sum(44) _{1...12} =												983.18	(44)

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

(45)m=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44		
	Total = Sum(45) _{1...12} =												1289.11	(45)

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

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42		(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):

1.13

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.68

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0.68

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	21.02	18.98	21.02	20.34	21.02	20.34	21.02	21.02	20.34	21.02	20.34	21.02		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

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

(57)m=	21.02	18.98	21.02	20.34	21.02	20.34	21.02	21.02	20.34	21.02	20.34	21.02		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

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

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

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

(62)m=

154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

 (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=

154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

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

1536.58

 (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=

61.25	54.05	56.92	51.24	50.37	45.22	43.64	47.6	47.43	53.12	55.9	59.85
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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
120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59

 (66)

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

(67)m=

39.11	34.73	28.25	21.39	15.99	13.5	14.58	18.96	25.44	32.3	37.7	40.19
-------	-------	-------	-------	-------	------	-------	-------	-------	------	------	-------

 (67)

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

(68)m=

261.88	264.6	257.75	243.17	224.77	207.47	195.92	193.2	200.05	214.63	233.03	250.33
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

 (68)

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

(69)m=

49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

82.33	80.44	76.51	71.16	67.7	62.81	58.66	63.98	65.87	71.4	77.64	80.45
-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------

 (72)

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

(73)m=

472.58	469.04	451.77	424.99	397.72	373.05	358.43	365.4	380.62	407.6	437.64	460.23
--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	--------

 (73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.52	x	10.63	x	0.72	x	0.7	=	20.5	(74)
North	0.9x	0.77	x	0.77	x	10.63	x	0.72	x	0.7	=	2.86	(74)
North	0.9x	0.77	x	5.52	x	20.32	x	0.72	x	0.7	=	39.18	(74)
North	0.9x	0.77	x	0.77	x	20.32	x	0.72	x	0.7	=	5.47	(74)
North	0.9x	0.77	x	5.52	x	34.53	x	0.72	x	0.7	=	66.57	(74)

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North	0.9x	0.77	x	0.77	x	34.53	x	0.72	x	0.7	=	9.29	(74)
North	0.9x	0.77	x	5.52	x	55.46	x	0.72	x	0.7	=	106.93	(74)
North	0.9x	0.77	x	0.77	x	55.46	x	0.72	x	0.7	=	14.92	(74)
North	0.9x	0.77	x	5.52	x	74.72	x	0.72	x	0.7	=	144.05	(74)
North	0.9x	0.77	x	0.77	x	74.72	x	0.72	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	5.52	x	79.99	x	0.72	x	0.7	=	154.21	(74)
North	0.9x	0.77	x	0.77	x	79.99	x	0.72	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	5.52	x	74.68	x	0.72	x	0.7	=	143.98	(74)
North	0.9x	0.77	x	0.77	x	74.68	x	0.72	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	5.52	x	59.25	x	0.72	x	0.7	=	114.23	(74)
North	0.9x	0.77	x	0.77	x	59.25	x	0.72	x	0.7	=	15.93	(74)
North	0.9x	0.77	x	5.52	x	41.52	x	0.72	x	0.7	=	80.04	(74)
North	0.9x	0.77	x	0.77	x	41.52	x	0.72	x	0.7	=	11.17	(74)
North	0.9x	0.77	x	5.52	x	24.19	x	0.72	x	0.7	=	46.64	(74)
North	0.9x	0.77	x	0.77	x	24.19	x	0.72	x	0.7	=	6.51	(74)
North	0.9x	0.77	x	5.52	x	13.12	x	0.72	x	0.7	=	25.29	(74)
North	0.9x	0.77	x	0.77	x	13.12	x	0.72	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	5.52	x	8.86	x	0.72	x	0.7	=	17.09	(74)
North	0.9x	0.77	x	0.77	x	8.86	x	0.72	x	0.7	=	2.38	(74)
South	0.9x	0.77	x	0.77	x	46.75	x	0.72	x	0.7	=	12.57	(78)
South	0.9x	0.77	x	0.77	x	76.57	x	0.72	x	0.7	=	20.59	(78)
South	0.9x	0.77	x	0.77	x	97.53	x	0.72	x	0.7	=	26.23	(78)
South	0.9x	0.77	x	0.77	x	110.23	x	0.72	x	0.7	=	29.65	(78)
South	0.9x	0.77	x	0.77	x	114.87	x	0.72	x	0.7	=	30.89	(78)
South	0.9x	0.77	x	0.77	x	110.55	x	0.72	x	0.7	=	29.73	(78)
South	0.9x	0.77	x	0.77	x	108.01	x	0.72	x	0.7	=	29.05	(78)
South	0.9x	0.77	x	0.77	x	104.89	x	0.72	x	0.7	=	28.21	(78)
South	0.9x	0.77	x	0.77	x	101.89	x	0.72	x	0.7	=	27.4	(78)
South	0.9x	0.77	x	0.77	x	82.59	x	0.72	x	0.7	=	22.21	(78)
South	0.9x	0.77	x	0.77	x	55.42	x	0.72	x	0.7	=	14.9	(78)
South	0.9x	0.77	x	0.77	x	40.4	x	0.72	x	0.7	=	10.86	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.72	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	1.3	x	19.64	x	0.72	x	0.7	=	17.84	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.72	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	1.3	x	38.42	x	0.72	x	0.7	=	34.89	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.72	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	1.3	x	63.27	x	0.72	x	0.7	=	57.46	(80)
West	0.9x	0.77	x	5.04	x	92.28	x	0.72	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	1.3	x	92.28	x	0.72	x	0.7	=	83.8	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.72	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	1.3	x	113.09	x	0.72	x	0.7	=	102.7	(80)

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West	0.9x	0.77	x	5.04	x	115.77	x	0.72	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	1.3	x	115.77	x	0.72	x	0.7	=	105.13	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.72	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	1.3	x	110.22	x	0.72	x	0.7	=	100.09	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.72	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	1.3	x	94.68	x	0.72	x	0.7	=	85.98	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.72	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	1.3	x	73.59	x	0.72	x	0.7	=	66.83	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.72	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	1.3	x	45.59	x	0.72	x	0.7	=	41.4	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.72	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	1.3	x	24.49	x	0.72	x	0.7	=	22.24	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.72	x	0.7	=	28.43	(80)
West	0.9x	0.77	x	1.3	x	16.15	x	0.72	x	0.7	=	14.67	(80)

Solar gains in watts, calculated for each month

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

(83)m=	88.34	167.76	270.93	397.74	496.82	514.38	487.22	411.01	314.98	197	109.07	73.44	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	-------	------

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

(84)m=	560.93	636.79	722.7	822.73	894.53	887.42	845.64	776.41	695.6	604.6	546.71	533.67	(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	0.95	0.87	0.69	0.5	0.34	0.25	0.28	0.47	0.78	0.94	0.98	(86)

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

(87)m=	20.54	20.68	20.85	20.97	21	21	21	21	21	20.95	20.74	20.51	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.25	20.25	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.93	0.84	0.66	0.46	0.3	0.21	0.24	0.42	0.74	0.93	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.64	19.85	20.08	20.23	20.26	20.27	20.27	20.27	20.26	20.21	19.93	19.61	(90)
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fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	19.95	20.13	20.34	20.48	20.51	20.52	20.52	20.52	20.51	20.46	20.2	19.91	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.95	20.13	20.34	20.48	20.51	20.52	20.52	20.52	20.51	20.46	20.2	19.91	(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	0.93	0.84	0.67	0.48	0.32	0.22	0.25	0.44	0.75	0.93	0.97	(94)
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SAP WorkSheet: New dwelling design stage

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

(95)m=	541.7	592.94	610.38	548.36	424.99	281.84	186.6	195.56	306.9	453.62	507.73	519.12	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	776.92	753.81	682.91	562.4	426.41	281.91	186.6	195.57	307.52	477.33	638.62	770.49	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	175	108.1	53.96	10.11	1.05	0	0	0	0	17.64	94.24	187.02	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 647.15 (98)

Space heating requirement in kWh/m²/year

10.61 (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) x [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)

175	108.1	53.96	10.11	1.05	0	0	0	0	17.64	94.24	187.02
-----	-------	-------	-------	------	---	---	---	---	-------	-------	--------

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

175	108.1	53.96	10.11	1.05	0	0	0	0	17.64	94.24	187.02
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Total (kWh/year) =Sum(211)_{1...5,10...12}= 647.15 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45
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Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100		(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45	
Total = Sum(219a) _{1...12} =												1536.58	(219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

647.15

Water heating fuel used

1536.58

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

133.96 (230a)

SAP WorkSheet: New dwelling design stage

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	133.96	(231)
Electricity for lighting		276.25	(232)
Electricity generated by PVs		-151.13	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2442.8	(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 =	85.36 (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 =	202.67 (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 =	17.67 (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 =	36.44 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x	13.19 x 0.01 =	0 (252)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		342.14 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.36	(257)
SAP rating (Section 12)		81.09	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	335.87 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	797.48 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1133.35 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	69.52 (267)
Electricity for lighting	(232) x	0.519 =	143.37 (268)
Energy saving/generation technologies			

SAP WorkSheet: New dwelling design stage

Item 1	0.519	=	-78.44	(269)
Total CO2, kg/year	sum of (265)...(271) =		1267.81	(272)
CO2 emissions per m²	(272) ÷ (4) =		20.78	(273)
El rating (section 14)			84	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	1986.74	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	4717.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6704.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	411.24	(267)
Electricity for lighting	(232) x	0	=	848.09	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-463.98	(269)
'Total Primary Energy	sum of (265)...(271) =			7499.39	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			122.94	(273)

DER WorkSheet: New dwelling design stage

User Details:

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

Property Address: Apartment 02

Address : Apartment 02, Brunswick Street, Manchester, M13 9TQ

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61 (1a)	2.4 (2a)	146.4 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	146.4 (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				0	0 (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) =	0	÷ (5) =	0 (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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15 (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) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

74.8 (23c)

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

(24a)m= 0.29 0.29 0.28 0.27 0.26 0.25 0.25 0.24 0.25 0.26 0.27 0.28 (24a)

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

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

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

if (22b)m < 0.5 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 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.29 0.29 0.28 0.27 0.26 0.25 0.25 0.24 0.25 0.26 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.04	$x1/[1/(1.4)+0.04] =$	6.68		(27)
Windows Type 2			1.3	$x1/[1/(1.4)+0.04] =$	1.72		(27)
Windows Type 3			5.52	$x1/[1/(1.4)+0.04] =$	7.32		(27)
Windows Type 4			0.77	$x1/[1/(1.4)+0.04] =$	1.02		(27)
Windows Type 5			0.77	$x1/[1/(1.4)+0.04] =$	1.02		(27)
Floor			17.3	x 0.15 =	2.595		(28)
Walls	45.46	14.7	30.76	x 0.2 =	6.15		(29)
Total area of elements, m²			62.76				(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) = 28.23 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 776.58 (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 7.48 (36)

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

Total fabric heat loss (33) + (36) = 35.72 (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=	13.94	13.79	13.63	12.86	12.71	11.94	11.94	11.79	12.25	12.71	13.02	13.33

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

(39)m= 49.66 49.5 49.35 48.58 48.43 47.66 47.66 47.5 47.96 48.43 48.73 49.04
Average = Sum(39)_{1...12} /12= 48.54 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.81	0.81	0.81	0.8	0.79	0.78	0.78	0.78	0.79	0.79	0.8	0.8		
Average = Sum(40) _{1...12} /12=													0.8	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.01

(42)

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

if TFA ≤ 13.9, N = 1

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

81.93

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

(44)m=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13		
Total = Sum(44) _{1...12} =													983.18	(44)

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

(45)m=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44		
Total = Sum(45) _{1...12} =													1289.11	(45)

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

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42		(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):

1.13

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.68

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0.68

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	21.02	18.98	21.02	20.34	21.02	20.34	21.02	21.02	20.34	21.02	20.34	21.02		(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	21.02	18.98	21.02	20.34	21.02	20.34	21.02	21.02	20.34	21.02	20.34	21.02		(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
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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=	154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45	(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	(63)
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Output from water heater

(64)m=	154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45	
Output from water heater (annual) _{1...12}												1536.58	(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=	61.25	54.05	56.92	51.24	50.37	45.22	43.64	47.6	47.43	53.12	55.9	59.85	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	(66)

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

(67)m=	15.64	13.89	11.3	8.55	6.39	5.4	5.83	7.58	10.18	12.92	15.08	16.08	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	175.46	177.28	172.69	162.93	150.6	139.01	131.27	129.45	134.03	143.8	156.13	167.72	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	(71)
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Water heating gains (Table 5)

(72)m=	82.33	80.44	76.51	71.16	67.7	62.81	58.66	63.98	65.87	71.4	77.64	80.45	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	326.58	324.76	313.65	295.79	277.83	260.36	248.91	254.15	263.23	281.27	302	317.39	(73)
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6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.52	x	10.63	x	0.72	x	0.7	=	20.5	(74)
North	0.9x	0.77	x	0.77	x	10.63	x	0.72	x	0.7	=	2.86	(74)
North	0.9x	0.77	x	5.52	x	20.32	x	0.72	x	0.7	=	39.18	(74)
North	0.9x	0.77	x	0.77	x	20.32	x	0.72	x	0.7	=	5.47	(74)
North	0.9x	0.77	x	5.52	x	34.53	x	0.72	x	0.7	=	66.57	(74)

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North	0.9x	0.77	x	0.77	x	34.53	x	0.72	x	0.7	=	9.29	(74)
North	0.9x	0.77	x	5.52	x	55.46	x	0.72	x	0.7	=	106.93	(74)
North	0.9x	0.77	x	0.77	x	55.46	x	0.72	x	0.7	=	14.92	(74)
North	0.9x	0.77	x	5.52	x	74.72	x	0.72	x	0.7	=	144.05	(74)
North	0.9x	0.77	x	0.77	x	74.72	x	0.72	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	5.52	x	79.99	x	0.72	x	0.7	=	154.21	(74)
North	0.9x	0.77	x	0.77	x	79.99	x	0.72	x	0.7	=	21.51	(74)
North	0.9x	0.77	x	5.52	x	74.68	x	0.72	x	0.7	=	143.98	(74)
North	0.9x	0.77	x	0.77	x	74.68	x	0.72	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	5.52	x	59.25	x	0.72	x	0.7	=	114.23	(74)
North	0.9x	0.77	x	0.77	x	59.25	x	0.72	x	0.7	=	15.93	(74)
North	0.9x	0.77	x	5.52	x	41.52	x	0.72	x	0.7	=	80.04	(74)
North	0.9x	0.77	x	0.77	x	41.52	x	0.72	x	0.7	=	11.17	(74)
North	0.9x	0.77	x	5.52	x	24.19	x	0.72	x	0.7	=	46.64	(74)
North	0.9x	0.77	x	0.77	x	24.19	x	0.72	x	0.7	=	6.51	(74)
North	0.9x	0.77	x	5.52	x	13.12	x	0.72	x	0.7	=	25.29	(74)
North	0.9x	0.77	x	0.77	x	13.12	x	0.72	x	0.7	=	3.53	(74)
North	0.9x	0.77	x	5.52	x	8.86	x	0.72	x	0.7	=	17.09	(74)
North	0.9x	0.77	x	0.77	x	8.86	x	0.72	x	0.7	=	2.38	(74)
South	0.9x	0.77	x	0.77	x	46.75	x	0.72	x	0.7	=	12.57	(78)
South	0.9x	0.77	x	0.77	x	76.57	x	0.72	x	0.7	=	20.59	(78)
South	0.9x	0.77	x	0.77	x	97.53	x	0.72	x	0.7	=	26.23	(78)
South	0.9x	0.77	x	0.77	x	110.23	x	0.72	x	0.7	=	29.65	(78)
South	0.9x	0.77	x	0.77	x	114.87	x	0.72	x	0.7	=	30.89	(78)
South	0.9x	0.77	x	0.77	x	110.55	x	0.72	x	0.7	=	29.73	(78)
South	0.9x	0.77	x	0.77	x	108.01	x	0.72	x	0.7	=	29.05	(78)
South	0.9x	0.77	x	0.77	x	104.89	x	0.72	x	0.7	=	28.21	(78)
South	0.9x	0.77	x	0.77	x	101.89	x	0.72	x	0.7	=	27.4	(78)
South	0.9x	0.77	x	0.77	x	82.59	x	0.72	x	0.7	=	22.21	(78)
South	0.9x	0.77	x	0.77	x	55.42	x	0.72	x	0.7	=	14.9	(78)
South	0.9x	0.77	x	0.77	x	40.4	x	0.72	x	0.7	=	10.86	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.72	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	1.3	x	19.64	x	0.72	x	0.7	=	17.84	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.72	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	1.3	x	38.42	x	0.72	x	0.7	=	34.89	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.72	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	1.3	x	63.27	x	0.72	x	0.7	=	57.46	(80)
West	0.9x	0.77	x	5.04	x	92.28	x	0.72	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	1.3	x	92.28	x	0.72	x	0.7	=	83.8	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.72	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	1.3	x	113.09	x	0.72	x	0.7	=	102.7	(80)

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West	0.9x	0.77	x	5.04	x	115.77	x	0.72	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	1.3	x	115.77	x	0.72	x	0.7	=	105.13	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.72	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	1.3	x	110.22	x	0.72	x	0.7	=	100.09	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.72	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	1.3	x	94.68	x	0.72	x	0.7	=	85.98	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.72	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	1.3	x	73.59	x	0.72	x	0.7	=	66.83	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.72	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	1.3	x	45.59	x	0.72	x	0.7	=	41.4	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.72	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	1.3	x	24.49	x	0.72	x	0.7	=	22.24	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.72	x	0.7	=	28.43	(80)
West	0.9x	0.77	x	1.3	x	16.15	x	0.72	x	0.7	=	14.67	(80)

Solar gains in watts, calculated for each month

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

(83)m=	88.34	167.76	270.93	397.74	496.82	514.38	487.22	411.01	314.98	197	109.07	73.44	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	414.92	492.52	584.58	693.53	774.65	774.74	736.12	665.16	578.2	478.27	411.07	390.83	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.98	0.94	0.79	0.58	0.39	0.28	0.33	0.57	0.89	0.99	1	(86)

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

(87)m=	20.32	20.49	20.73	20.93	20.99	21	21	21	20.99	20.87	20.55	20.29	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.25	20.25	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.93	0.75	0.53	0.35	0.24	0.28	0.51	0.86	0.98	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.33	19.58	19.92	20.19	20.25	20.27	20.27	20.27	20.26	20.13	19.68	19.29	(90)
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fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	19.66	19.88	20.19	20.44	20.5	20.52	20.52	20.52	20.51	20.38	19.98	19.63	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.66	19.88	20.19	20.44	20.5	20.52	20.52	20.52	20.51	20.38	19.98	19.63	(93)
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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
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Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.92	0.76	0.55	0.36	0.25	0.29	0.53	0.87	0.98	0.99	(94)
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DER WorkSheet: New dwelling design stage

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

(95)m=	411.67	481.42	540.32	529.47	422.95	281.74	186.59	195.54	305.52	415.09	402.76	388.64	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	762.87	741.79	675.56	560.57	426.22	281.9	186.6	195.57	307.39	473.5	627.48	756.56	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	261.29	174.97	100.61	22.39	2.43	0	0	0	0	43.45	161.8	273.74	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1040.69	(98)

Space heating requirement in kWh/m²/year

17.06	(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) x [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
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Space heating requirement (calculated above)

261.29	174.97	100.61	22.39	2.43	0	0	0	0	43.45	161.8	273.74
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(211)m = {[[(98)m x (204)] } x 100 ÷ (206) (211)

261.29	174.97	100.61	22.39	2.43	0	0	0	0	43.45	161.8	273.74		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1040.69	(211)

Space heating fuel (secondary), kWh/month

= {[[(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45
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Efficiency of water heater 100 (216)

(217)m= (217)

100	100	100	100	100	100	100	100	100	100	100	100
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	154.67	135.88	141.64	125.5	121.92	107.41	101.71	113.61	114.04	130.21	139.53	150.45	
Total = Sum(219a) _{1...12} =												1536.58	(219)

Annual totals

Space heating fuel used, main system 1 kWh/year 1040.69 kWh/year

Water heating fuel used 1536.58

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 133.96 (230a)

DER WorkSheet: New dwelling design stage

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	133.96	(231)
Electricity for lighting		276.25	(232)
Electricity generated by PVs		-151.13	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2836.34	(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	=	540.12	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	797.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1337.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	69.52	(267)
Electricity for lighting	(232) x	0.519	=	143.37	(268)
Energy saving/generation technologies Item 1		0.519	=	-78.44	(269)
Total CO2, kg/year		sum of (265)...(271) =		1472.06	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		24.13	(273)
El rating (section 14)				81	(274)

TER WorkSheet: New dwelling design stage

User Details:

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

Property Address: Apartment 02

Address : Apartment 02, Brunswick Street, Manchester, M13 9TQ

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61 (1a)	2.4 (2a)	146.4 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	146.4 (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) =	0.14 (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			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.39 (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) =		0.33 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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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TER WorkSheet: New dwelling design stage

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39
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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= 0.59 0.58 0.58 0.57 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.04	$\times 1/[1/(1.4) + 0.04] =$	6.68		(27)
Windows Type 2			1.3	$\times 1/[1/(1.4) + 0.04] =$	1.72		(27)
Windows Type 3			5.52	$\times 1/[1/(1.4) + 0.04] =$	7.32		(27)
Windows Type 4			0.77	$\times 1/[1/(1.4) + 0.04] =$	1.02		(27)
Windows Type 5			0.77	$\times 1/[1/(1.4) + 0.04] =$	1.02		(27)
Floor			17.3	x 0.13 =	2.249		(28)
Walls	45.46	14.7	30.76	x 0.18 =	5.54		(29)
Total area of elements, m²			62.76				(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) = 27.27 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 776.58 (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 7.77 (36)

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

Total fabric heat loss (33) + (36) = 35.04 (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=	28.4	28.23	28.07	27.31	27.17	26.51	26.51	26.39	26.76	27.17	27.46	27.76

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

(39)m=	63.44	63.27	63.11	62.36	62.21	61.55	61.55	61.43	61.81	62.21	62.5	62.8
Average = Sum(39) _{1...12} /12=												62.35 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.04	1.04	1.03	1.02	1.02	1.01	1.01	1.01	1.01	1.02	1.02	1.03		
	Average = Sum(40) _{1...12} /12=												1.02	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.01

(42)

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

if TFA ≤ 13.9, N = 1

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

81.93

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

(44)m=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13		
	Total = Sum(44) _{1...12} =												983.18	(44)

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

(45)m=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44		
	Total = Sum(45) _{1...12} =												1289.11	(45)

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

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42		(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):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

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

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

(62)m=	180.25	158.98	167.22	150.25	147.5	132.17	127.28	139.18	138.79	155.79	164.28	176.03	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	180.25	158.98	167.22	150.25	147.5	132.17	127.28	139.18	138.79	155.79	164.28	176.03	
Output from water heater (annual) _{1...12}												1837.72	(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=	81.72	72.54	77.38	71.04	70.83	65.03	64.1	68.06	67.23	73.58	75.71	80.31	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	(66)

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

(67)m=	15.64	13.89	11.3	8.55	6.39	5.4	5.83	7.58	10.18	12.92	15.08	16.08	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	175.46	177.28	172.69	162.93	150.6	139.01	131.27	129.45	134.03	143.8	156.13	167.72	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	(71)
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Water heating gains (Table 5)

(72)m=	109.83	107.94	104.01	98.67	95.2	90.31	86.16	91.48	93.37	98.9	105.15	107.95	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	357.08	355.26	344.15	326.29	308.34	290.87	279.41	284.66	293.73	311.77	332.51	347.89	(73)
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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 m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
North	0.9x	0.77	x	5.52	x	10.63	x	0.63	x	0.7	=	17.94	(74)
North	0.9x	0.77	x	0.77	x	10.63	x	0.63	x	0.7	=	2.5	(74)
North	0.9x	0.77	x	5.52	x	20.32	x	0.63	x	0.7	=	34.28	(74)
North	0.9x	0.77	x	0.77	x	20.32	x	0.63	x	0.7	=	4.78	(74)
North	0.9x	0.77	x	5.52	x	34.53	x	0.63	x	0.7	=	58.25	(74)

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North	0.9x	0.77	x	0.77	x	34.53	x	0.63	x	0.7	=	8.13	(74)
North	0.9x	0.77	x	5.52	x	55.46	x	0.63	x	0.7	=	93.57	(74)
North	0.9x	0.77	x	0.77	x	55.46	x	0.63	x	0.7	=	13.05	(74)
North	0.9x	0.77	x	5.52	x	74.72	x	0.63	x	0.7	=	126.04	(74)
North	0.9x	0.77	x	0.77	x	74.72	x	0.63	x	0.7	=	17.58	(74)
North	0.9x	0.77	x	5.52	x	79.99	x	0.63	x	0.7	=	134.93	(74)
North	0.9x	0.77	x	0.77	x	79.99	x	0.63	x	0.7	=	18.82	(74)
North	0.9x	0.77	x	5.52	x	74.68	x	0.63	x	0.7	=	125.98	(74)
North	0.9x	0.77	x	0.77	x	74.68	x	0.63	x	0.7	=	17.57	(74)
North	0.9x	0.77	x	5.52	x	59.25	x	0.63	x	0.7	=	99.95	(74)
North	0.9x	0.77	x	0.77	x	59.25	x	0.63	x	0.7	=	13.94	(74)
North	0.9x	0.77	x	5.52	x	41.52	x	0.63	x	0.7	=	70.04	(74)
North	0.9x	0.77	x	0.77	x	41.52	x	0.63	x	0.7	=	9.77	(74)
North	0.9x	0.77	x	5.52	x	24.19	x	0.63	x	0.7	=	40.81	(74)
North	0.9x	0.77	x	0.77	x	24.19	x	0.63	x	0.7	=	5.69	(74)
North	0.9x	0.77	x	5.52	x	13.12	x	0.63	x	0.7	=	22.13	(74)
North	0.9x	0.77	x	0.77	x	13.12	x	0.63	x	0.7	=	3.09	(74)
North	0.9x	0.77	x	5.52	x	8.86	x	0.63	x	0.7	=	14.95	(74)
North	0.9x	0.77	x	0.77	x	8.86	x	0.63	x	0.7	=	2.09	(74)
South	0.9x	0.77	x	0.77	x	46.75	x	0.63	x	0.7	=	11	(78)
South	0.9x	0.77	x	0.77	x	76.57	x	0.63	x	0.7	=	18.02	(78)
South	0.9x	0.77	x	0.77	x	97.53	x	0.63	x	0.7	=	22.95	(78)
South	0.9x	0.77	x	0.77	x	110.23	x	0.63	x	0.7	=	25.94	(78)
South	0.9x	0.77	x	0.77	x	114.87	x	0.63	x	0.7	=	27.03	(78)
South	0.9x	0.77	x	0.77	x	110.55	x	0.63	x	0.7	=	26.01	(78)
South	0.9x	0.77	x	0.77	x	108.01	x	0.63	x	0.7	=	25.42	(78)
South	0.9x	0.77	x	0.77	x	104.89	x	0.63	x	0.7	=	24.68	(78)
South	0.9x	0.77	x	0.77	x	101.89	x	0.63	x	0.7	=	23.98	(78)
South	0.9x	0.77	x	0.77	x	82.59	x	0.63	x	0.7	=	19.43	(78)
South	0.9x	0.77	x	0.77	x	55.42	x	0.63	x	0.7	=	13.04	(78)
South	0.9x	0.77	x	0.77	x	40.4	x	0.63	x	0.7	=	9.51	(78)
West	0.9x	0.77	x	5.04	x	19.64	x	0.63	x	0.7	=	30.25	(80)
West	0.9x	0.77	x	1.3	x	19.64	x	0.63	x	0.7	=	15.61	(80)
West	0.9x	0.77	x	5.04	x	38.42	x	0.63	x	0.7	=	59.18	(80)
West	0.9x	0.77	x	1.3	x	38.42	x	0.63	x	0.7	=	30.53	(80)
West	0.9x	0.77	x	5.04	x	63.27	x	0.63	x	0.7	=	97.46	(80)
West	0.9x	0.77	x	1.3	x	63.27	x	0.63	x	0.7	=	50.28	(80)
West	0.9x	0.77	x	5.04	x	92.28	x	0.63	x	0.7	=	142.14	(80)
West	0.9x	0.77	x	1.3	x	92.28	x	0.63	x	0.7	=	73.33	(80)
West	0.9x	0.77	x	5.04	x	113.09	x	0.63	x	0.7	=	174.2	(80)
West	0.9x	0.77	x	1.3	x	113.09	x	0.63	x	0.7	=	89.86	(80)

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West	0.9x	0.77	x	5.04	x	115.77	x	0.63	x	0.7	=	178.32	(80)
West	0.9x	0.77	x	1.3	x	115.77	x	0.63	x	0.7	=	91.99	(80)
West	0.9x	0.77	x	5.04	x	110.22	x	0.63	x	0.7	=	169.77	(80)
West	0.9x	0.77	x	1.3	x	110.22	x	0.63	x	0.7	=	87.58	(80)
West	0.9x	0.77	x	5.04	x	94.68	x	0.63	x	0.7	=	145.83	(80)
West	0.9x	0.77	x	1.3	x	94.68	x	0.63	x	0.7	=	75.23	(80)
West	0.9x	0.77	x	5.04	x	73.59	x	0.63	x	0.7	=	113.35	(80)
West	0.9x	0.77	x	1.3	x	73.59	x	0.63	x	0.7	=	58.47	(80)
West	0.9x	0.77	x	5.04	x	45.59	x	0.63	x	0.7	=	70.22	(80)
West	0.9x	0.77	x	1.3	x	45.59	x	0.63	x	0.7	=	36.22	(80)
West	0.9x	0.77	x	5.04	x	24.49	x	0.63	x	0.7	=	37.72	(80)
West	0.9x	0.77	x	1.3	x	24.49	x	0.63	x	0.7	=	19.46	(80)
West	0.9x	0.77	x	5.04	x	16.15	x	0.63	x	0.7	=	24.88	(80)
West	0.9x	0.77	x	1.3	x	16.15	x	0.63	x	0.7	=	12.83	(80)

Solar gains in watts, calculated for each month

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

(83)m=	77.3	146.79	237.06	348.02	434.72	450.08	426.32	359.63	275.61	172.38	95.44	64.26	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	434.38	502.05	581.21	674.32	743.05	740.95	705.72	644.29	569.33	484.15	427.94	412.15	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.89	0.73	0.52	0.38	0.44	0.7	0.94	0.99	1	(86)

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

(87)m=	20.01	20.18	20.45	20.76	20.94	20.99	21	21	20.96	20.7	20.3	19.99	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.05	20.05	20.06	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.06	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.86	0.67	0.45	0.3	0.35	0.63	0.92	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.74	18.98	19.37	19.8	20.01	20.07	20.08	20.08	20.04	19.73	19.17	18.71	(90)
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fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	19.17	19.39	19.73	20.12	20.32	20.38	20.39	20.39	20.35	20.06	19.55	19.14	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.17	19.39	19.73	20.12	20.32	20.38	20.39	20.39	20.35	20.06	19.55	19.14	(93)
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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
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Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.86	0.68	0.48	0.33	0.38	0.65	0.92	0.98	0.99	(94)
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TER WorkSheet: New dwelling design stage

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

(95)m=	430.94	493.41	554.33	581.26	508.62	352.73	232.75	244.23	370.88	443.73	420.68	409.62	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	943.5	916.67	834.99	699.63	536.48	355.82	233.07	244.91	386.45	588.36	778.01	938.16	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	381.34	284.43	208.81	85.22	20.72	0	0	0	0	107.61	257.27	393.23	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1738.64 (98)

Space heating requirement in kWh/m²/year

28.5 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

381.34	284.43	208.81	85.22	20.72	0	0	0	0	107.61	257.27	393.23
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(211)m = [(98)m x (204)] } x 100 ÷ (206)

(211)

407.85	304.21	223.32	91.15	22.17	0	0	0	0	115.09	275.16	420.57
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Total (kWh/year) =Sum(211)_{1...5,10...12} = 1859.51 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

180.25	158.98	167.22	150.25	147.5	132.17	127.28	139.18	138.79	155.79	164.28	176.03
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Efficiency of water heater

79.8 (216)

(217)m=	86.77	86.35	85.41	83.37	80.98	79.8	79.8	79.8	79.8	83.85	86.01	86.9	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	207.74	184.11	195.79	180.23	182.15	165.62	159.5	174.42	173.92	185.79	191.02	202.57	
Total = Sum(219a) _{1...12} =													2202.86 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1859.51

Water heating fuel used

2202.86

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		276.25	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4413.62	(338)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	401.65	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	475.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =				877.47	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	143.37	(268)
Total CO2, kg/year		sum of (265)...(271) =			1059.77	(272)
TER =					25.28	(273)